MANTHAN NEET 2025

CHEMISTRY

Mole concept

Lecture-1



Sarvesh Sir

Teaching Experience

- 19 years of teaching experience
- Worked at H.O.D of Chemistry
- Worked at Academic director of Chemistry
- Ex. : Senior Faculty of Chemistry

  Bansal Classes (Kota)

  Career Point (Kota)

  Narayana Delhi
- Mentored NEET Holding

  Ranks : 7, 19, 27………



Sarvesh Sir

Content for Physical Chemistry

New NCERT

- Book: (NCERT CHEMISTRY) ②
- Reference Material : Class Notes ①
- Things to Solve : 1. DPP ✓
  2. Class Examples ✓
  3. Modules (Periodic HW) ✓ Tavta
  4. PYQ ✓
  5. CSD ✓ Concept by Sarvesh dixit.

19-Questⁿ NEET-2024

Target = 100% Questⁿ-2025

6. NCERT
- → Example
- → Exercise
- → Index
- → Exemplar

Topic

MATTER

CLASSIFICATION OF MATTER

MATTER

Anythings that have mass and occupied space or volume

- → Book
- → pen
- → Sarvesh dixit
- → Air
- → Water → a) Yes ✓
  b) NO

NONMATTER

→ 1) NO Mass

→ 2) not occupied volume or space

Ex → Love

Ex → feeling

Ex → Memory

Ex → temperature

Ex → Energy

Ex → light

Csd-1 → Matter = have Mass and occupied volume or space

Nonmatter = NO Mass and not occupied space.

- Matter
  - PURE Substance → Collection of only one type of molecules or atom
  - Mixture → Collection of more than one type of molecules or atom.

- pure substance
  - Element → Jab molecule ek hi type ke atom se form huwa ho
  - Compound → Jab molecule different type ke atom se form huwa ho.

Q. Select the correct example of matter

A. Sound → ✗

B. Heat → ✗

C. Book ✓

D. None of these

Q → How many is example of matter → (6)

1) Memory	→ Non-matter	Book	→ matter
2) Sound	→ Nonmatter	Pen	→ matter
Sunlight	→ Nonmatter	Phone	→ matter
Love	→ Nonmatter	Mass	→ matter
Energy	→ Nonmatter	Air	→ matter
Memories	→ Nonmatter	H_2 gas	→ matter

Q. Which is not example of matter.

- A. Sound
- B. Pen
- C. Air
- D. Water

Q. How many species is not a example of matter Light, Heat, Sound, Air, Water, wire, sun Light, Time, Love, Memories ,Energy, Phone

A. 1

B. 8

C. 4

D. 5

Q. Match the following

List-1	List_2
A Phone	P- Matter -
B Book	Q- Non-matter -
C Memories	
D Heat	

A → P
B → P
C → Q
D → Q

CLASSIFICATION MATTER

Mass → a) yes ✓ / b) NO

Space → occupied

1) pure substance

3) Mixture → Mass
→ space

Matter

Mixture

→ Collection of more than one type of molecule or atom

Ex → Air → $N_2 + O_2 + CO_2 + H_2O(v)$

Ex → Allol → copperpyride → Cu+Fe+te

Ex → aq. sol^n sugar → H_2O + sugar

Pure substance

→ Collection of only one type of molecule or atom

→ H_2O , Ex → Na(s)

→ H_2 gas   Ex → NaCl crystal

Q. Which of the following particles are the example of the mixture

A. Air → $N_2 + O_2 + CO_2 + H_2O$

B. Common salt in water solution
└ $NaCl + H_2O + - -$

C. Maggi → $H_2O + - -$

D. All ✓

Q. Which of the following particles are the example of the pure subscenes

A. CO_2 gas → CO_2

B. H_2 gas → H_2

C. Na(s) → Na

D. All ✓

Q. Find out the ratio of example of mixture and pure substance in given example
Air, Cold drink, Tea, Na(s), He(g), P_4, sugar solution

M M M P P P M

A $\frac{4}{3}$

B $\frac{3}{4}$

C $\frac{1}{2}$

D $\frac{3}{2}$

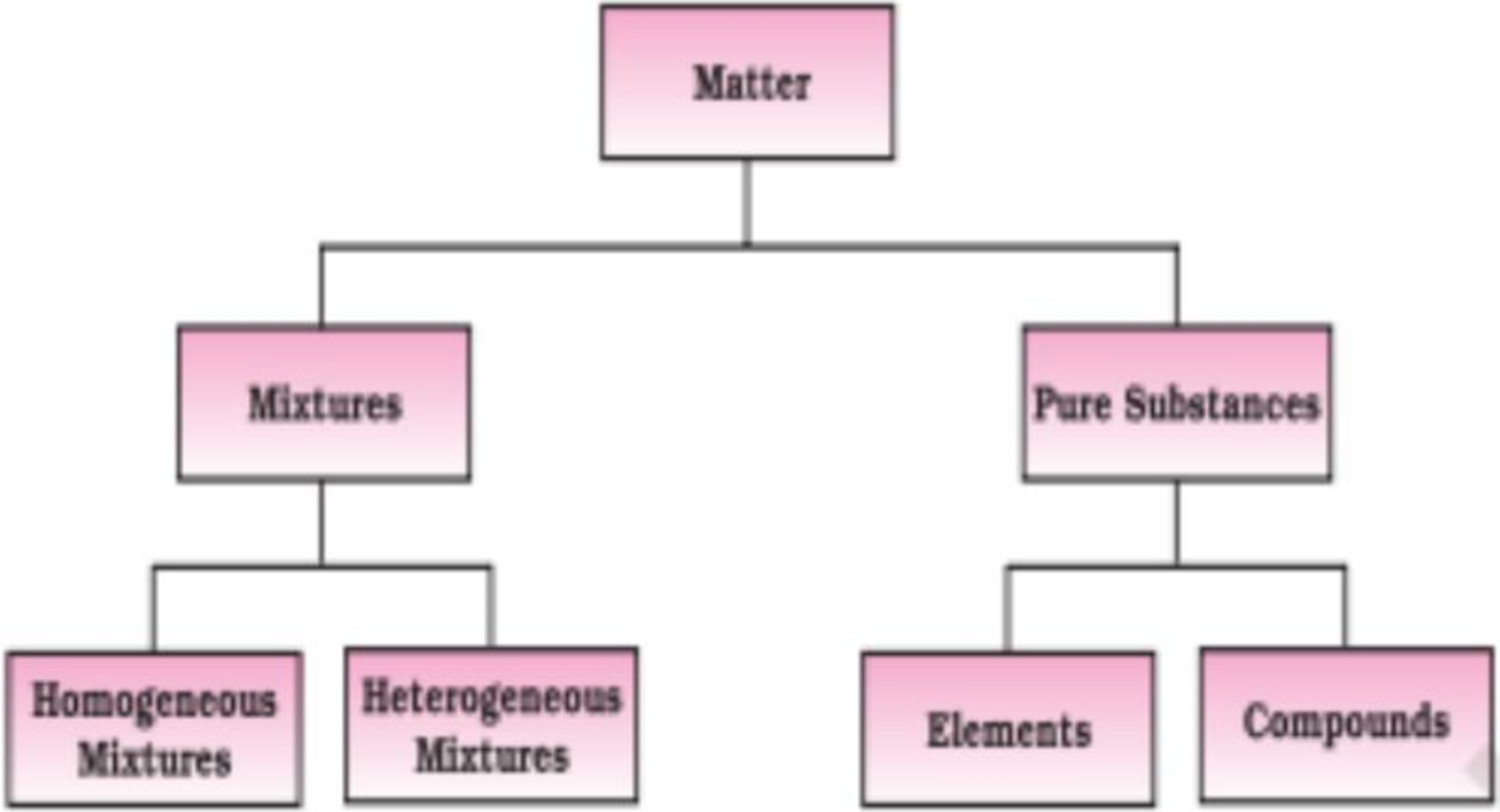
$$\frac{M \rightarrow 4}{P \rightarrow 3}$$

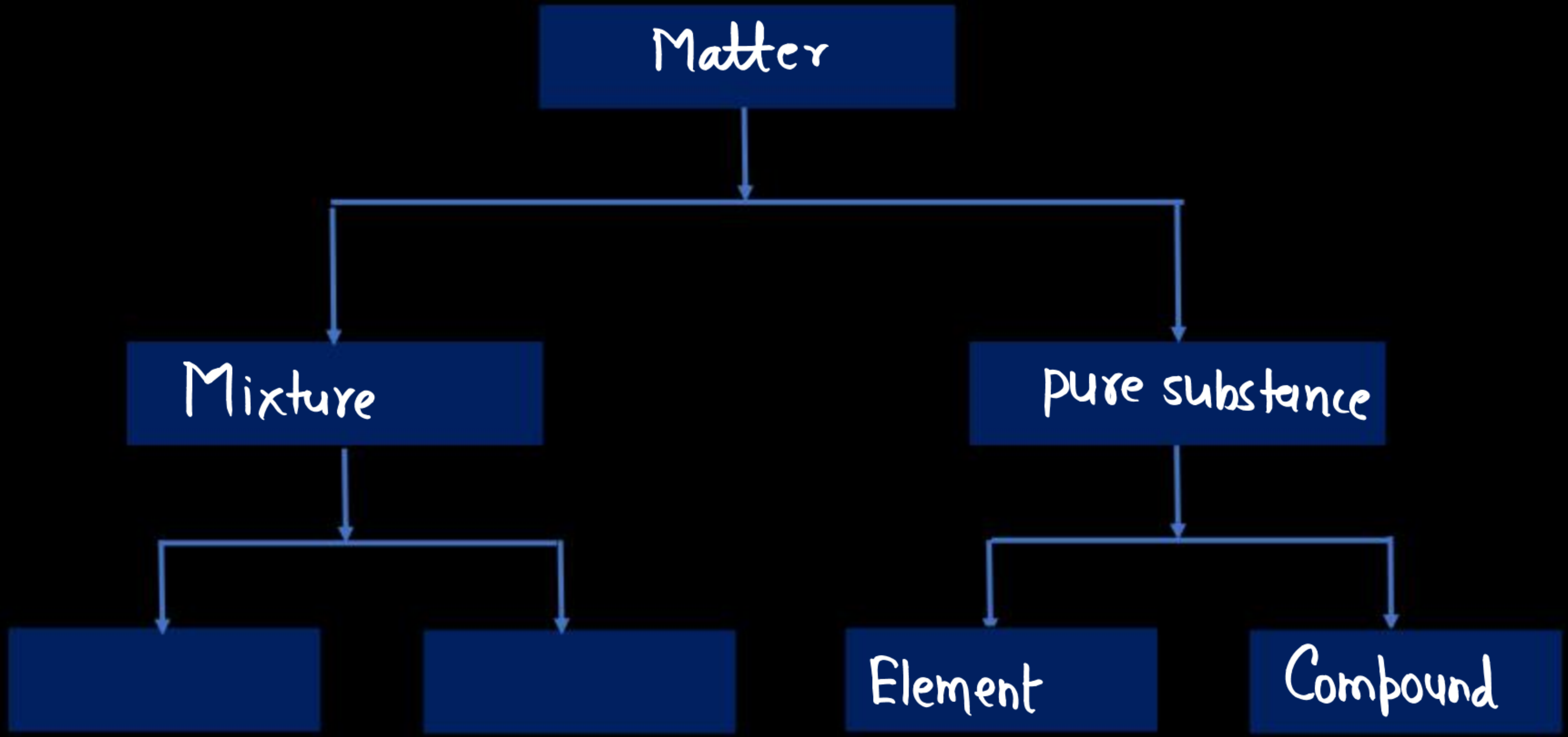
Q

a) Matter | p) Cold drink
b) NON matter | q) ice
c) Pure substance | r) Temperature
d) Mixture | s) Heat
 | t) ORE

A → p, q, t   C → q,

B → r, s   D → p, t


Matter
Mixtures
Pure Substances
Homogeneous Mixtures
Heterogeneous Mixtures
Elements
Compounds


Matter
Mixture
pure substance
Element
Compound

pure substance

pure substance → Collechon of only one type of molecule oratom

Element

- → Mass → yes
- → Space occupied → yes
- → only one molecule oratom = Collect
- → molecule form only same type of atom → H_2, P_4, S_8, N_2, Na(s)

Compound

- Mass ✓
- Space occupied ✓
- → Collechon of one type molecule or atom
- → molecules form by different type of atom
- → CO_2, H_2O, NO_2,

Q Yellow phosphorous is a example of

a) matter

b) pure substance

c) Element

d) All ✓

P_4 unit → Collection

Q. Which of the following particles are the example of the element?

A. P_4 ✓

B. Air → $N_2 + O_2$ + etc

C. H_2O ✗

D. CO_2 ✗

Matter
↓
pure subs
↓
Element

Q Calculate the total No. of Compound in given example

H_2 ✗, Air ✗, NaCl aq. solⁿ ✗, CO_2 gas ✓, Water ✓ (H_2O), H_2SO_4 pure ✓,

ORE ✗, Lime stone ✗, Alloly ✗, pure Benzene liquid ✓ (C_6H_6)

Ca ka ore hota hai

a) 2

b) 3

c) 4 ✓

d) 5

Matter
↓
pure subs
↓
Compound

Q. Select the correct example of elements.

A. O_2 ✓

B. Air → mixture

C. CO_2 ✗

D. H_2O ✗

Lime stone
↓
$CaCO_3$ ore hota hai
↓
→ $CaCO_3$ + impurity

Q. How many particles are the example of compound. H_2O, CO_2, Air, Sugar Solution, Na(s), $H_2(g)$

A. 2

B. 1

C. 3

D. 4

Matter → pure subs → Compound

Note → Qsd → 2

Class Test Question Sarvesh dixit

Sugar solution → $C_{12}H_{22}O_{11} + H_2O$

THANK YOU !!

MANTHAN NEET 2025

SANKALP NEET VEDANTU

Class test → Qsd-
2 Quest^n

CHEMISTRY

Mole concept

Lecture-2



Sarvesh Sir

Topic

MATTER

CLASSIFICATION OF MATTER

BASIC INFORMATION

QSD -1. Select the term which is example of nonmatter

(A) Air → matter

(B) hate → non matter

(C) speed → non matter

(D) B & C both ✓

QSD -2 . Select the term which is example of element

(A) Air → mixture

(B) Water → comp. → H_2O

(C) Oxygen gas → element

(D) Carbon di oxide gas

$\frac{2}{2}$

Mixture

→ Collection of different type of molecules or atom

Homogeneous

→ different type molecule = Collect

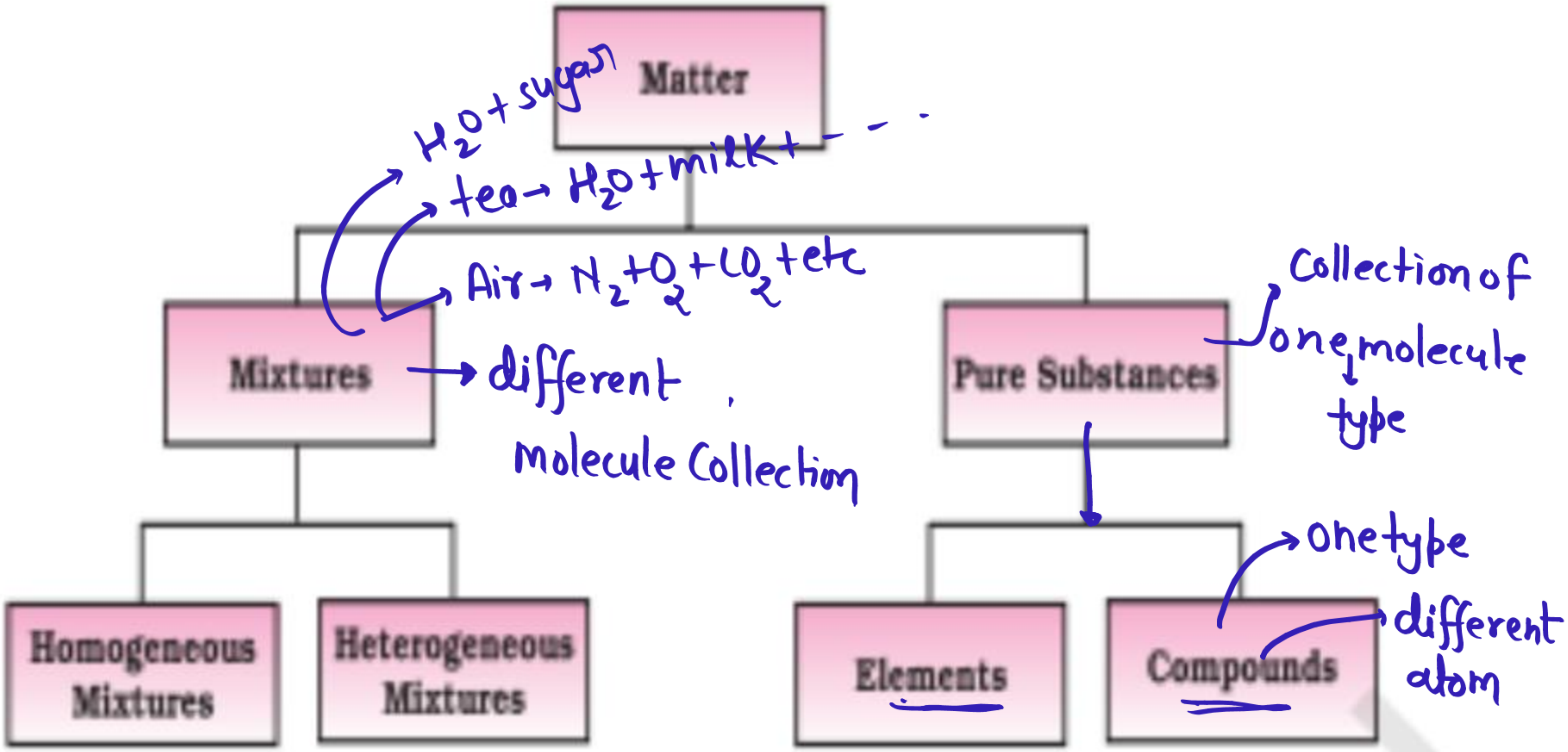
→ Uniformally distributed in whole mixture

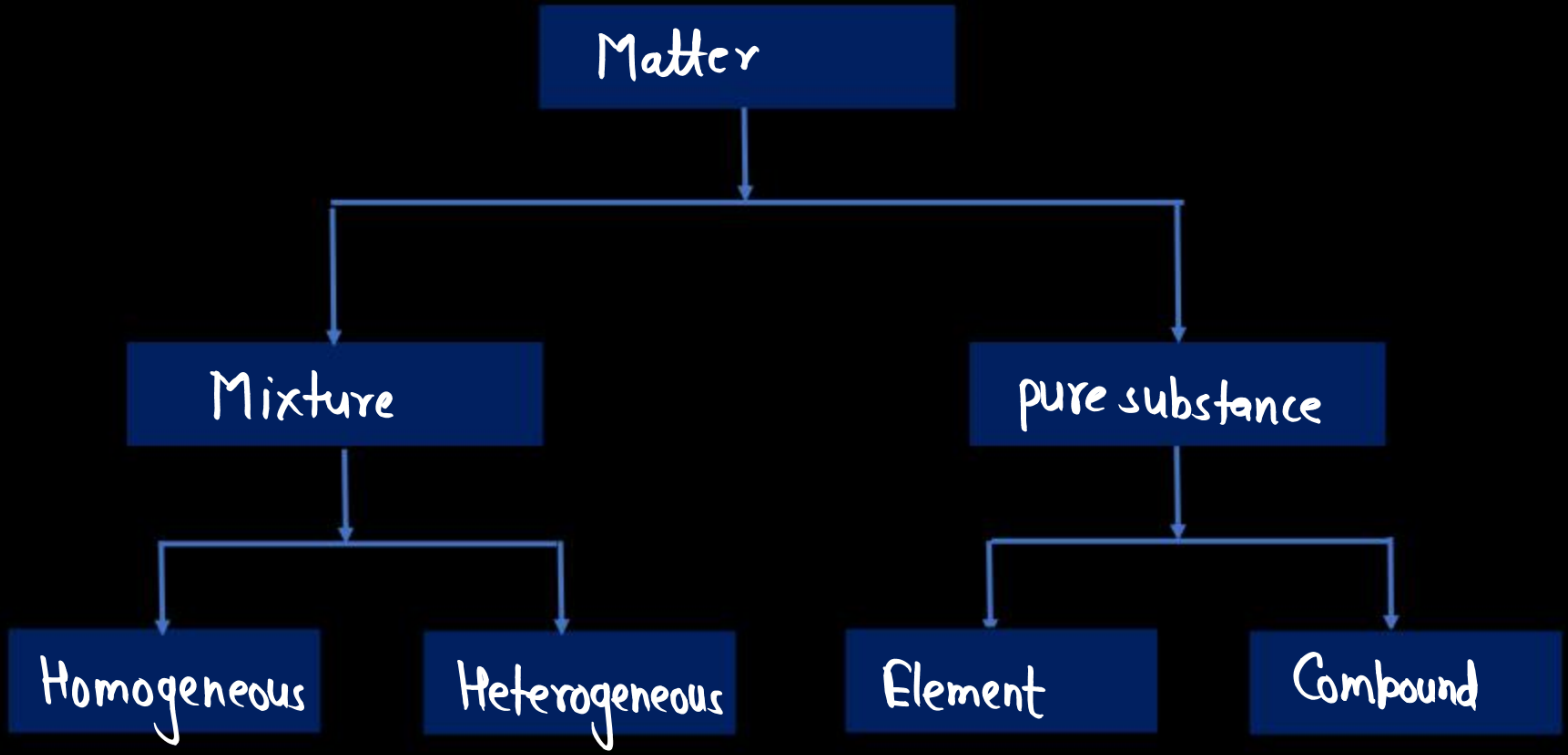
Heterogeneous

→ different type molecule = Collection

→ not uniformally distributed in whole solution or mixture

Ex → oil + H_2O


Matter
Mixtures
Pure Substances
Homogeneous Mixtures
Heterogeneous Mixtures
Elements
Compounds
H2O + sugar
tea → H2O + milk + - - .
Air → N2 + O2 + CO2 + etc
different molecule Collection
Collection of one molecule type
one type
different atom


Matter
Mixture
pure substance
Homogeneous
Heterogeneous
Element
Compound

Q → pitrol + water

a) Homo. mixture

✓ b) Hetero. mixture

Q → C_2H_5OH + water

✓ a) Homo. mixture

b) Hetero. mixture

Q. Match the following

List-I	List-II
(a) Element	(p) Air
(b) Compound	(q) Sugar Solution
(c) Mixture	(r) H_2O
	(s) O_2 gas

A. (a – s), (b – r), (c – p, q)

B. (a – r), (b – s), (c – p, q)

C. (a – s, r), (b – r, q), (c – p)

D. a – s), (b – r, q), (c – p)

C – P, Q

milk + H_2O → mixture

Heterogeneous

Effect of physical state

STATES OF MATTER

→ generally 3-physical state

1) Gas →

2) liquid →

3) Solid →

MASS OF SUBSTANCE

→ Mass of subs does not depend upon physical state

$$(\text{Mass})_g = (\text{Mass})_{liq.} = (\text{Mass})_{solid}$$

Ex → 2 gram CO_2 gas → Condense Krne ke bad

Mass of liq. CO_2:

a) 2g ✓ b) W > 2g c) W < 2g d) Can not say

$C_{SD} = 2$

→ Mass of subs. does not depend upon physical state of matter

$$(\text{Mass})_{gas} = (\text{Mass})_{liq} = (\text{Mass})_{solid}$$

→ Number of molecules of subs. does not depend upon physical state of matter

$$(\text{Mole})_{gas} = (\text{Mole})_{liq} = (\text{Mole})_{solid}$$

→ volume of subs. depend upon physical state of matter

$$V_g > V_{liq.} > V_{solid}$$

→ **Note** → $(V_{H_2O})_{liq.} < (V_{H_2O})_{solid}$ due to formation of cavity.

→ density of subs. also depend upon physical state of matter

→ $d = \frac{\text{Mass}}{\text{Vol.}} \Rightarrow d_g < d_{liq} < d_{solid}$

Note → $d_{ice} < d_{H_2O(liq)}$.

→ temperature always put in kelvin (K).

→ $T(K) = 273 + T(^\circ C)$

→ $T(F^\circ) = \frac{9}{5} T(^\circ C) + 32$

Q. 12 gram sodium solid convert into vapour (gas) of sodium atom. How many gram of sodium (Na) vapour (gas)?

A. 11 gram

B. 12 gram

C. 13 gram

D. 14 gram

NUMBER OF MOLECULES

No. of molecules or atoms does not depend upon physical state of matter

$$(\text{Mole})_{gas} = (\text{Mole})_{liq} = (\text{Mole})_{solid}$$

$$(\text{No.})_{gas} = (\text{NO})_{liq.} = (\text{NO})_{solid}$$

Ex → 10^{23} molecules of CO_2 gas Converted into liquid CO_2. How many molecules of CO_2 in liq.

a) 10^{23}

b) greater than 10^{23}

c) less than 10^{23}

Q. 100 molecules of CO_2 gas present in a container. If CO_2 gas converted in liquid CO_2. How many molecules of CO_2 present in liquid CO_2?

A. 10 molecules → 3%

B. 100 molecules ← 96-97

C. 1 molecule

D. 1000 molecules

Q 7 × 10^{21} atom of He gas at 300K temp. present in 10L Container
Calculate No. of He-atom in solid He, if temp. decreases 300K to −300K

a) 7 × 10^{21} → 92%

b) greater than 7 × 10^{21}

c) less than 7 × 10^{21}

d) NONE

VOLUME OF SUBSTANCE

→ $V_{gas} > V_{liq} > V_{solid}$ → generally

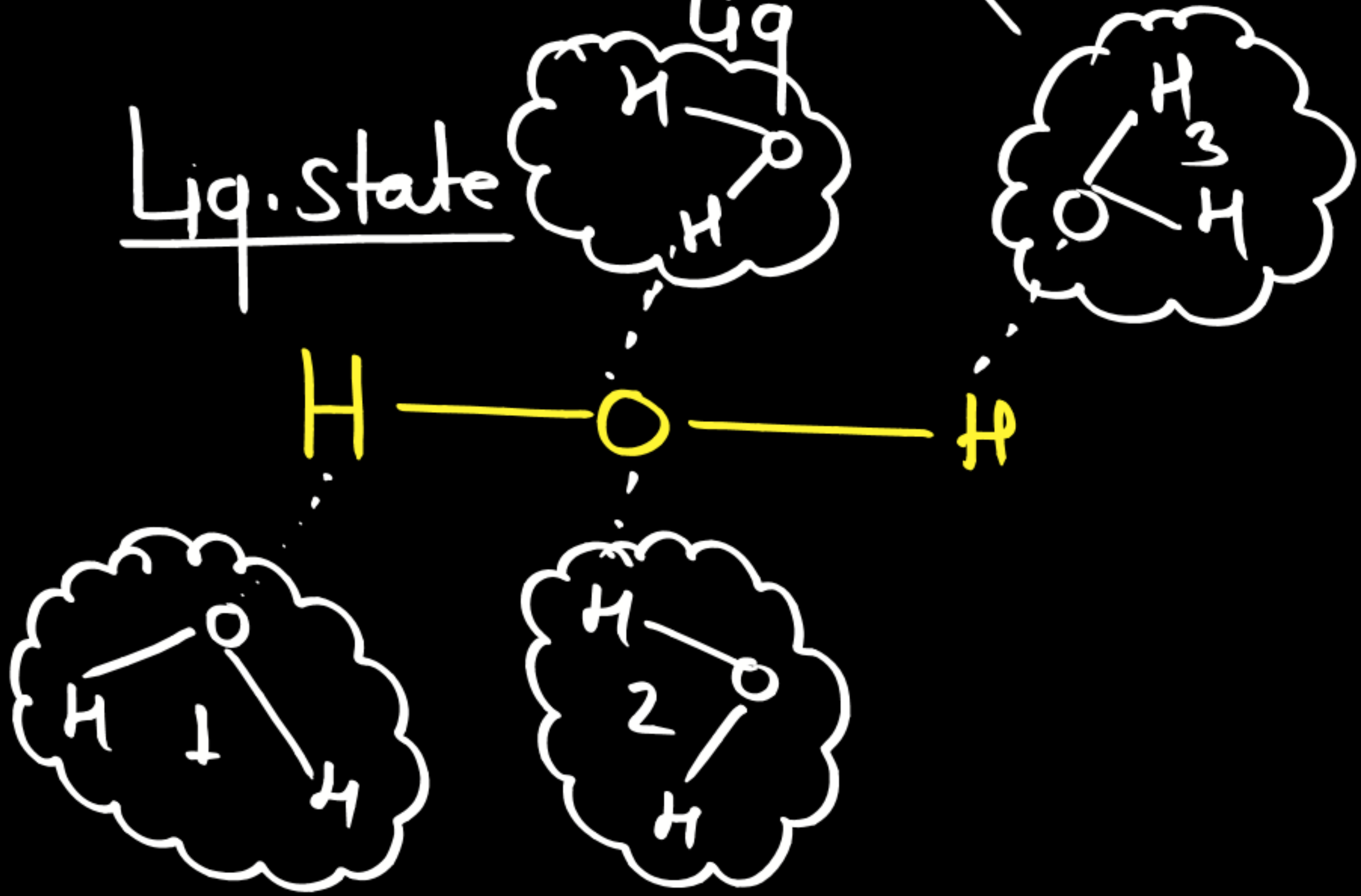
Volume of Substance depend upon physical state of matter

→ 10ml H_2O liquid → Convert H_2O vap.

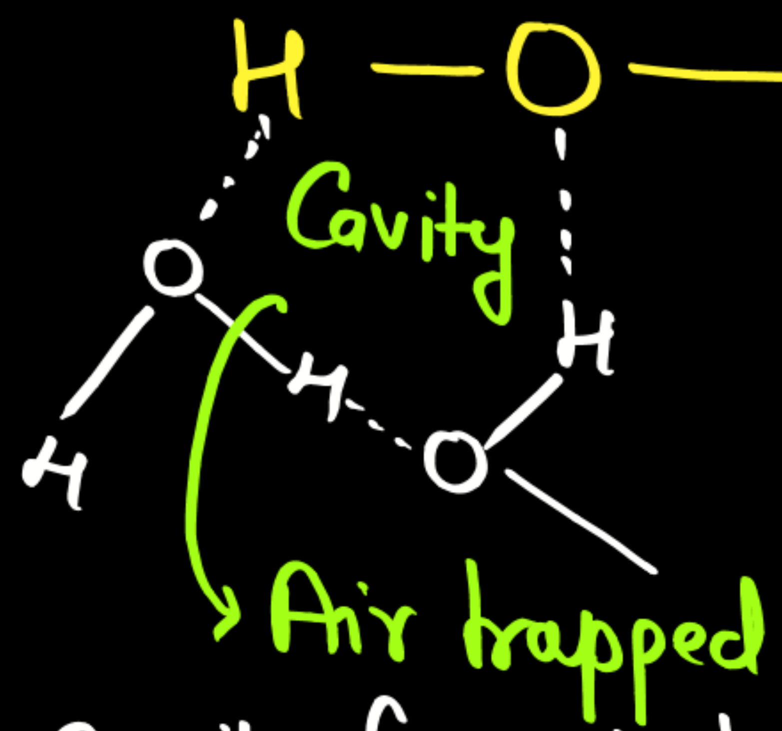
a) $(V_{H_2O})_{v.p.} > 10ml$ b) $(V_{H_2O})_{vp} < 10ml$

Note → $(V_{H_2O})_{liq} < (V_{H_2O})_{solid}$

Liq. state



Solid state → $(H_2O + Air)$



→ Open like structure

→ No cavity form (close structure)

→ Cavity form krta hai

→ Air trapped ho jati hai

Q. 9 gram water liquid occupied 500 mL volume. If whole water converted into gas phase. Select the correct statements.

A. Volume of H_2O in gas phase = 500 mL

B. Volume of H_2O in gas phase is greater than 500 mL

C. Volume of H_2O in gas phase is less than 500 mL

D. None of these

liq $\longrightarrow$ gas

$V_{liq} < V_g$

$w_{liq} = w_g$

DENSITY OF SUBSTANCE

$$\text{density} = \frac{\text{Mass}}{\text{Volume}}$$

- Mass → not depend upon physical state
- Volume → depend upon physical state

→ density of subs. depend upon physical state of matter.

$$\downarrow \text{density} \propto \frac{1}{\text{Volume}\uparrow}$$

→ $V_g > V_{liq} > V_{solid}$

→ $d_{gas} < d_{liq} < d_{solid}$

Note → $d_{ice} < d_{H_2O\,liq.}$

→ $V_{ice} > V_{H_2O\,liq.}$

Q. Which of the following properties change (effected) when substance change in physical state?

A. Mass of substance

B. Number of molecules/atoms of substance

C. Density of substance

D. Volume of substance

Mass, Number → ×

Volume, density → ✓

(C, D)

Q. Which of the following properties decreases when 4 gram CO_2 gas converted into CO_2 liquid?

A. Mass of CO_2 → ⊗

B. Volume of CO_2 – gas → liq. → $V_g > V_{liq}$

C. Number of molecules of CO_2 → ⊗

D. Density of CO_2

CO_2 gas ⟶ CO_2 liquid ↑ $d = \frac{M}{V \downarrow}$

→ decrease

Temperature

- $^\circ C$
- K
- $^\circ F$
- temp. always put in Kelvin (K) unit

$$T(F^\circ) = \frac{9}{5} T(^\circ C) + 32$$

- $K = 273.15 + ^\circ C \simeq 273 + ^\circ C$

$$T(K) = 273 + T(^\circ C)$$

Q → temp. of O_2 gas is 40°c. Calculate temp. of O_2 gas in F° scale.

a) 49 F

b) 110 F

c) 32 F

~~d)~~ NONE

$$F^\circ = \frac{9}{5} \times {}^\circ C + 32$$

$$= \frac{9}{\cancel{5}} \times \overset{8}{\cancel{40}} + 32$$

$$= 72 + 32$$

104 F

THANK YOU !!

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CHEMISTRY

Mole concept

Lecture-3



Sarvesh Sir

Topic

Basic calculation of number

QSD -1 . Select the properties which is depend of physical state of matter

(A) volume ✓

(B) mass

(C) mole

(D) temperature

Temp , Mass, Number → x

Volume → ✓

density → ✓

QSD -2 . 2gram ice melt at 1C and store in 10 litre vessel at 20C temperature , how many gram of liquid water form approximate

(A) Greater than 2 gram

(B) Less than 2 gram

(C) Approx. 2 gram

(D) Can not say

2gram - ice

↓

2gram → water liq.

$\frac{2}{2}$

Pressure

gas → free motion → speed → high

liquid → motion → speed → Avg

Solid → fixed → speed → zero

$\rightarrow P_g > P_{liq} \approx P_{solid}$

Number of atoms in one molecule

Ex → H_2O → water

→ 1 molecule H_2O = 2 H-atom + 1 O-atom

Ex → C_2H_6 → ethane

⇒ 1 molecule C_2H_6 = 2 C-atom + 6 H-atom

Ex → $C_2H_4O_4$

1 molecule $C_2H_4O_4$

$2+4+4=10$

C-atom = 2

H-atom = 4

O-atom = 4

total atom = 2+4+4=10

Ex → $H_2S_4O_6$

H-atom = 2

S-atom = 4

O-atom = 6

total Atom = 12

Ques – calculate total no of c atom in one molecule of sucrose ($C_{12}H_{22}O_{11}$)

(A) 12

(B) 22

(C) 11

(D) 45

Ques - calculate total no of H- atom in one molecule of sucrose ($C_{12}H_{22}O_{11}$)

(A) 12

(B) 22 ✓

(C) 11

(D) 45

Ques - calculate total no of O- atom in one molecule of sucrose ($C_{12}H_{22}O_{11}$)

(A) 12

(B)22

(C)11

(D)45

Ques - calculate number Of total atom in one molecule of sucrose ($C_{12}H_{22}O_{11}$)

12+22+11=45

(A) 12

(B) 22

(C) 11

(D) 45

Ex → 1 molecule H_2O = 2 H-atom + 1 O-atom = 3 atom

↓

100 or 10^2 H_2O = 2×10^2 H-atom, 10^2 O-atom, 3×10^2 atom

Ques - calculate number Of total atoms in 100 molecule of sucrose ($C_{12}H_{22}O_{11}$)

$12+22+11=45$

$45 \times 100 = 4500$

(A) 1200

(B) 2200

(C) 1100

(D) 4500 ✓

$C_{SD} = 3$

1) Suppose ⇒ $A_x B_y C_z$ ---

→ 1 molecule ($A_x B_y C_z$ ---)

→ No. of A-atom = x

→ No. of B-atom = y

→ No. of C-atom = z

→ total atom = $x + y + z +$ --

2) η molecules of $A_x B_y C_z$ ---

→ total No. of A-atom = ηx

→ total No. of B-atom = ηy

→ total No. of C-atom = ηz

→ total No. of atoms = $\eta (x + y + z)$

3) Suppose → ionic comp → $A_x B_y$

$$A_x B_y \longrightarrow xA^{+y} + yB^{-x}$$

No. of A-ion = x

No. of B-ion = y

4) Atom → $_{Z}X^{A}$

- No. of p^{+} in one atom = Z
- No. of e^{-} in one atom = Z
- No. of n^{0} in one atom = $A-Z$
- total No. of $e^{-}+p^{+}+n^{0}$ in one atom = $Z+\cancel{Z}+A-\cancel{Z} = \boxed{A+Z}$

SO_4^{-2}

Ques – calculate number Of total cations in one unit of $Al_2(SO_4)_3$.

(A) 2

(B) 4

(C) 3

(D) 5

$Al_2(SO_4)_3 \longrightarrow 2Al^{+3} + 3SO_4^{-2}$

Ques – calculate number Of total anions in one unit of Al2(SO4)3 .

(A) 2
(B) 4
(C) 3 ✓
(D) 5

−6

$Al_2(SO_4)_3 \longrightarrow 2Al^{+3} + 3SO_4^{-2}$

2 = Cation = Jiske uper +ve charge ho
3 = Anion = Jiske uper −ve Charge ho

total ion = 5

Salt = Cation Anion

CO_3^{-2}
SO_4^{-2}
NO_3^{-}
X^{-}
OH^{-}
PO_4^{-3}
SO_3^{-2}
NO_2^{-}

Ques – calculate number Of total ions in one unit of $Al_2(SO_4)_3$.

2+3 = 5

(A) 2

(B) 4

(C) 3

(D) 5

Q → $Zn(NO_3)_2$

No. of Cation = 1

No. of Anion = 2

No. of Ions = 1+2=3

Q → 10^{10} molecule of $Zn(NO_3)_2$

No. of Zn^{+2} = 1×10^{10}

No. of NO_3^- = 2×10^{10}

No. of ions = 3×10^{10}

Ques – calculate number Of total ions in 850 unit of $Al_2(SO_4)_3$.

2+3 = 5

5X850

(A) 2X850

(B)4X850

(C)3X850

(D)5X850

SO_4^{-2}

Q → $Al_2(SO_4)_3$

No. of $Al^{+3} = 2$

No. of $SO_4^{-2} = 3$

No. of ions = 5

No. of S-atom = 3

No. of O-atom = 12

Q → How many molecules of $Al_2(SO_4)_3$ form by 1 Al-atom

Solⁿ → $1\ Al_2(SO_4)_3 \rightarrow 2Al^{+3} + 3SO_4^{-2}$

$\frac{1}{2}$ molecule $Al_2(SO_4)_3$

Q → How many glucose ($C_6H_{12}O_6$) molecules form by 2 C-atom.

a) 1 molecule

b) $\frac{1}{2}$ molecule

c) $\frac{1}{3}$ molecule

d) $\frac{1}{6}$ molecule

$6C = 1$

$1C = \frac{1}{6}$

$2C = \frac{1}{6} \times 2 = \frac{1}{3}$

$6C = 1$

$1C = \frac{1}{6}$

$10^{10}C = \frac{1}{6} \times 10^{10}$

(b) 10^{10} C-atom, How many molecules of glucose form ($C_6H_{12}O_6$)

→ a) $\frac{1}{6} \times 10^{10}$

b) NONE

Number of e, p and n in one molecule

Pressure $\propto$ temp → (same phase)

↓

same phase pr, ye concept applicable hai

↓

physical state change na ho

Number of e, p and n in one Atom

Atom → Representation = $_{Z}X^{A}$

Z = Atomic Number → definition = total No. of proton in one atom

($Z = P = e$)

A = Mass Number

↓

definition = Sum of No. of proton + No. of neutron

$A = p + n \Rightarrow n = A - p = \boxed{A - Z}$

Q → $_{1}H^{3}$ → Titrium (Isotope of H-atom)

(3 → A, 1 → Z)

No. of p^+ = Z = 1

No. of e^- = Z = 1

No. of n^0 = A − Z = 3 − 1 = 2

Sum of $e^- + p^+ + n^0$ = A + Z = 3 + 1 = 4

Ques – total number of electron in S-atom .

(A) 12

(B) 14

(C) 16

(D) 32

Ques – total number of proton in S-atom .

$p^+ = Z = 16$

(A) 12

(B)14

(C)16

(D)32

Ques – total number of neutron in S-atom . $\left({}_{16}S^{32} \right.$

$n^0 = A - Z = 32 - 16 = 16$

(A) 12

(B) 14

(C) 16 ✓

(D) 32

Ques – total sum of e^-, p^+ and n^0 in one S-atom. $\left({}_{16}S^{32}\right)$

$$e^- + p^+ + n^0 = A + Z = 32 + 16 = \underline{48}$$

(A) 46

(B) 44

(C) 48 ✓

(D) 32

Ques – total sum of e, p and n in 100 S-atom. $\left({}_{16}S^{32}\right)$

$$e^- + p^+ + n^0 = A + Z = 32 + 16 = 48$$

(A) 46x100

(B) 44x100

(C) 48x100 ✓

(D) 32x100

$1 \longrightarrow 48$

$100 \longrightarrow 48 \times 100$

Ques - Atom X Contains $20e^-$ and 18 neutrons. Calculate Atomic No. (Z) and Mass No. of atom-X (A)

(A) 20, 38 ✓

(B) 20, 18

(C) 20, 15

(D) NONE

$$e^- = Z = 20$$

$$n^0 = A - Z$$

$$18 = A - 20$$

$$A = 18 + 20 = 38$$

Q → Calculate sum of No. of neutron in all isotopes of H-atom ($_1H^1$, $_1H^2$ & $_1H^3$)

a) 2

b) 3 ✓

c) 4

d) 5

$\eta = A - Z$

$_1H^1 \longrightarrow \eta = 1-1 = 0$

$_1H^2 \longrightarrow \eta = 2-1 = 1$

$_1H^3 \longrightarrow \eta = 3-1 = 2$

$0+1+2 = 3$

THANK YOU !!

SANKALP NEET
VEDANTU

MANTHAN NEET 2025

DPP-1

CHEMISTRY

Mole concept

Lecture-4



Sarvesh Sir

Topic

mole

QSD -1 . How many atoms of Sulphur present in 2561 molecules of $H_2S_6O_4$

(A) 2561/6

(B) 2561X6

(C) 6

(D) 2561X12

$H_2S_6O_4$

6-atom S

2561x6 S-atom

QSD -2 . Calculate total number of electron present in 10000 atom of nitrogen

(A) 10000/7

✓(B) 70000

(C) 1000x7

(D) 7

$_{7}N^{14}$; $Z = 7$, $A = 14$

No. of $e^- = 7$

$10{,}000 \times 7 = 70{,}000$

Qsd3. 0 .14 mole of o-atom present in S_3O_9. How many mole of S_3O_9

(A) 0.14 mole

(B) 0.07 mole

(C) $\frac{14}{900}$ mole

(D) 0.14 × 7 mole

S_3O_9

9 O-atom = 1

1 O-atom = $\frac{1}{9}$

0.14 mole atom = $\frac{1}{9} \times 0.14$ mole = $\frac{14}{900}$ mole

Number of e, p and n in one molecule

Revision

1-atom → $_{Z}X^{A}$ ⇒ $_{17}Cl^{35}$

last class

$e^- = Z = 17$

$p^+ = Z = 17$

$n^0 = A - Z = 35 - 17$

$e^- + p^+ + n^0 = A + Z = 35 + 17$

Ex → H_2O

= 2 H-atom + 1 O-atom

→ total No. of n^0 in one H_2O molecule = $2 \times 0 + 1 \times 8 = 8$

→ total No. of $e^- + p^+ + n^0 = 10e^- + 10p^+ + 8n^0$ in one molecule H_2O = 28

total No. of e^- in one molecule of $H_2O = 2 \times 1 + 1 \times 8 = 2 + 8 = 10e^-$

$_1H^1$, $_8O^{16}$

total No. of p^+ in one molecule of $H_2O = 10p^+$ $(2 \times 1 + 1 \times 8 = 10p^+)$

$n^0 = A - Z$
- → $H = 1 - 1 = 0$
- $O = 16 - 8 = 8$

H_2O

$2({}_1H^1) + ({}_8O^{16}) \times 1$

$e^- + p^+ + n^0 = A + Z$

(ek atom) → H = 1+1 = 2

O = 16+8 = 24

total No. of $e^- + p^+ + n^0$ in one molecule of $H_2O = 2 \times 2 + 1 \times 24 = \underline{28}$

Ex → CO_2 ${}_6C^{12}$, ${}_8O^{16}$ A−Z, (A+Z)

total No. of e^- in 1 molecule of CO_2 = $1 \times 6 + 2 \times 8 = 6 + 16 = 22$

total No. of p^+ in 1 molecule of CO_2 = 22

total No. of n^0 in 1 molecule of CO_2 = $1(12-6) + 2(16-8) = 22$

total No. of $e^- + p^+ + n^0$ in 1 molecule of CO_2 = $1(12+6) + 2 \times (16+8)$

$= 18 + 48 = 66$

$C_{SD} = 4$

→ $A_x B_y C_z \cdots$ = Molecule

→ total No. of e^- in one molecule
$= (x \times Z_A + y \times Z_B + z \times Z_C)$

→ total No. of p^+ in one molecule
$= (x Z_A + y \times Z_B + z \times Z_C)$

→ total No. of n^0 in one molecule
$= x(A-Z)_A + y(A-Z)_B + z \times (A-Z)_C$

→ total No. of $e^- + p^+ + n^0$ in one molecule
$= x(A+Z)_A + y(A+Z)_B + z(A+Z)_C$

→ No. of p^+ & n^0 in Ions = No. of p^+ & n^0 in its neutral species

→ No. of e^- in Ions $(A^{\pm n})$
= No. of e^- in its neutral form $-(\pm n)$

→ total Charge of ion $(A^{\pm n})$
$= \pm n \times 1.6 \times 10^{-19}\, C$ (single ion)

Ques – how many electron present in H_2SO_4

$\textcircled{1}H^1$ $\textcircled{16}S^{32}$ $\textcircled{8}O^{16}$

(A) 50 ✓

(B) 98

(C) 32

(D) 49

No. of e^- in one $H_2SO_4 = 2Z_H + 1 \times Z_S + 4 \times Z_O$

$= 2 \times 1 + 1 \times 16 + 4 \times 8$

$= 2 + 16 + 32$

$= 50$

1-atom → $_Z X^A$

$e^- = Z$

$p^+ = Z$

$n^0 = A - Z$

$e^- + p^+ + n^0 = A + Z$

$_1H^1$ $_{16}S^{32}$ $_8O^{16}$

Ques – how many electron present in 10260 molecules H_2SO_4

$\Rightarrow 2\times1 + 1\times16 + 4\times8 = 50$

10260×50

(A) 50 X10260

(B) 98 X10260

(C) 32 X 10260

(D) 49 X10260

NO. of e^-, p^+ and n^0 in 1- ion

Ion → 2 type = (1.) Cation = lose of $e^- \Rightarrow$ +ve charge

(2) Anion = gain of $e^- \Rightarrow$ -ve charge

<u>Note</u> ⇒ p^+ aur n^0 = na to p^+ aur n^0 = gain hote hai aur na lose hote hai

⇒ NO. of p^+ & n^0 in Ion = No. of p^+ & n^0 its neutral form

Ex → No. of p^+ in Al^{+3} = ${}_{13}Al^{27}$ = 13

No. of n^0 in Al^{+3} = A − Z = 27 − 13 = 14

${}_{6}C^{12}$

${}_{8}O^{16}$

Ex → No. of p^+ in CO_3^{-2} ⇒ 1×6 + 3×8 = 30

No. of n^0 in CO_3^{-2} ⇒ 1(12−6) + 3(16−8) = 6 + 3×8 = 30

Al^{+3} ⇒ Meaning ⇒ 3 electron lose by one Al-atom = 13−3 = 10

CO_3^{2-} ⇒ Meaning ⇒ 2 $\bar{e}$ gain by CO_3 Unit

= 1×6 + 3×8 = 30 + 2 = 32

total No. of e^- in ions ($A^{\pm n}$ → Cation = A^{+n}, Anion = A^{-n})

> = total No. of e^- in its neutral species − (n with sign)

Ex → Ca^{+2} ⇒ No. of e^- in Ca^{+2} = $20 - (+2) = 18$

$_{20}Ca^{40}$

O^{-2} ⇒ No. of e^- in O^{-2} = $8 - (-2) = 8 + 2 = \underline{\underline{10}}$

Ques – How many proton in aluminum ion (Al^{+3})

$p^+ = Z = {}_{13}Al^{27}$

(A) 13

(B) 10

(C) 16

(D) 13x3

Ques – Calculate total number of electron in sulphate ion $(SO4)^{-2}$

$_{16}S^{32}$ $_{8}O^{16}$

$= 1\times16 + 4\times8$

$48+2=50$ $= 16+32 = 48$

(A) 50

(B) 48

(C) 46

(D) 96

Ques – Calculate total number of electron in 1000 sulphate ion $(SO_4)^{-2}$

$1 \times 16 + 4 \times 8 = 48$

$48 + 2 = 50$

(A) 50/1000

1000×50

(B) 48X1000

(C) 46X1000

(D) 50X1000 ✓

Ques – How many electron in aluminum ion (Al^{+3})

$13 - 3 = \underline{10}$

(A)13

(B)10

(C)16

(D)13x3

charge of ions

$1e^-$ Charge $= 1.6 \times 10^{-19} C = \frac{1F}{N_A} = \frac{96500}{N_A} C$

$100 e^-$ Charge $= 100 \times 1.6 \times 10^{-19} C$

Al^{+3} = Al pr $3e^-$ lose Kr Raha hai (Relative charge)

- Real or Actual charge nahi hai
- $+3 \times 1.6 \times 10^{-19} C$

CO_3^{-2} = $2e^-$ gain ho rahe

= $2e^-$ ka charge CO_3 pr ayega

= $-2 \times 1.6 \times 10^{-19}$ C

Ion = $A^{\pm n}$ ⇒ $\pm n \times 1.6 \times 10^{-19}$ C hota ek Ion

Q. Select the correct charge present in Zarconium (Zr^{+4}) ion in Column.

✗ a) $+4C$

✓ b) $+4 \times 1.6 \times 10^{-19} C$

✗ c) $-4 \times 1.6 \times 10^{-19} C$

✗ d) $+1.6 \times 10^{-19} C$

Zr^{+4}

$+4 \times 1.6 \times 10^{-19} C$

Q. total charge of 10^{21} Aluminium Ions (Al^{+3})

a) $3 \times 1.6 \times 10^{-19} C$

b) $3 \times 1.6 \times 10^{2} C$ ✓

c) $1.6 \times 10^{-19} \times 10^{21} C$

d) NONE

Al^{+3}

$+3 \times 1.6 \times 10^{-19} C$

$= 3 \times 1.6 \times 10^{-19} \times 10^{21} C$

$= 3 \times 1.6 \times 10^{2} C$

Ques –charge of 5000 sulphate ion (SO_4^{-2})

SO_4^{-2}

(A) $-2 \times 1.6 \times 10^{-19}$ C

(B) $-5000 \times 1.6 \times 10^{-19}$ C

(C) $-2 \times 5000 \times 1.6 \times 10^{-19}$ C

(D) NONE

$-2 \times 1.6 \times 10^{-19}$ C

$-5000 \times 2 \times 1.6 \times 10^{-19}$ C

Q Calculate total charge of 6×10^{16} ions of PO_4^{-3}

a) $3 \times 6 \times 10^{16}$ C

b) $3 \times 6 \times 10^{16} \times 10^{-19}$ C

c) $3 \times 6 \times 1.6 \times 10^{-3}$ C ✓

d) $3 \times 6 \times 1.6 \times 10^{3}$ C

PO_4^{-3}

$= -3 \times 1.6 \times 10^{-19}$ C

$-3 \times 1.6 \times 10^{-19} \times 6 \times 10^{16}$ C

$= -3 \times 6 \times 1.6 \times 10^{-3}$ C

19
16
―
3

Q – Calculate sum of e^-, p^+ and n^0 of all isotopes of Carbon atom ($_6C^{12}$, $_6C^{13}$, $_6C^{14}$)

a) 210

~~b) 57~~

c) 54

d) 56

A+Z

$(12+6)$ $13+6$ $14+6$

$18 + 19 + 20$

$= 60 - 3 = 57$

THANK YOU !!

MANTHAN NEET 2025

Liquid sol^n → Lec-2

Live = 8pm

Coming

Sat, Sunday → pune

Vedantu Centre

CHEMISTRY

Mole concept

Lecture-5



Sarvesh Sir

Topic

mole

QSD -1. Calculate total number of proton in 10 molecules of $H_2S_6O_4$

$_{1}H^{1}$, $_{16}S^{32}$ $_{8}O^{16}$

(A) 1300 ✓

(B) 130

(C) 10

(D) 2580

$\Rightarrow 1\times2+16\times6+8\times4$

$= 130$

$130\times10 = \underline{1300}$

QSD -2 . Calculate total sum of neutron in all isotopes of chlorine (17 cl37 , 17cl 35)

$_{17}Cl^{37}, \; _{17}Cl^{35}$

(A) 37

(B)35

(C) 34

(D) 38 ✓

$n^0 = A - Z = 37 - 17 = 20$

$A - Z = 35 - 17 = 18$

38

QSD-3 –total charge of 100 sodium ion coulomb

(A) $100\times 1.6\times 10^{-19}$ C

(B) 100C

(C) $100\times 1.6\times 10^{-19}$ ESU

(D) NONE

mole

12 gram $-C^{12}-$ isotope = Jitne No. of C-atom

↓

Utne hi No. of intities (atom, e^-, p^+, n^0, molecules) 1 mole me hote hai

C-isotope:
- C^{12} → Non Radioactive
- C^{13} ⎤
- C^{14} ⎦ → Radioactive

12 gram C^{12} ⇒ 6.022×10^{23} No. of C-atom

1 mole = 6.022×10^{23} No. of intities

↓

Avogadro's No. (N_0 or N_A)

1 mole is the mass of substance that Contains as many as initites that present in 12 gram Carbon (C^{12})-12 isotopes

→ 1 mole = 6.022×10^{23} Number = N_0 or N_A ⇒ Avogadro's No.

→ 7^{th} S.I. Unit ⇒ Mass

→ Jiska mole = Usi Ke number

Ex→ 1 mole CO_2 = 6.022×10^{23} No. of CO_2

Ex→ 1 mole oxygen atom = 6.022×10^{23} No. of O-atom

Ex → 1 mole oxygen molecule = 6.022×10^{23} No. of O_2 molecule

Ex → 1 mole oxygen = 6.022×10^{23} No. of O_2 molecule

↓

Consider = natural form (Jis form me nature exist Krta hai)

Q 1 mole of phosphorous present in 10 litre Container
Select Correct option

(P$_4$ unit ke form me exist krta hai)

a) N_A No. of P-atom in Container

b) N_A No. of P_2-molecule in Container

c) N_A No. of P_4-unit in Container ✓✓

d) NONE

No. of mole in term Number

$$\text{No. of mole} = \frac{\text{given Number}}{6.022 \times 10^{23}}$$

Ex→ 6.022×10^{2} molecules of CO_2 gas present Container.
How many mole of CO_2 gas in Container.

Sol^n = No. of mole of $CO_2 = \dfrac{6.022 \times 10^{2}}{6.022 \times 10^{23}} = 10^{-21}$ mole

Q. 3.011×10^{20} molecule of H_2O vapourise at high temp.
How many mole of vapour of H_2O form.

a) 5×10^{-2} mole

✓ b) 5×10^{-4} mole

c) 5×10^{-3} mole

d) NONE

$10^{20} \times 10^{-23} = 10^{20-23} = 10^{-3}$

No. of mole of $H_2O = \frac{3.011 \times 10^{20}}{6.022 \times 10^{23}} = \frac{10}{2} \times 10^{-3}$

$= \frac{10}{2} \times 10^{-4} = 5 \times 10^{-4}$

Ex → ① $C_6H_{12}O_6$

1 molecule = 6 C + 12 H + 6 O = 24 total atom

1 mole molecule = 6 mole C
12 mole H
6 mole O
= 24 mole atom

Ex → 1 mole H_2SO_4, Contains

a) 2 H-atom

b) 2 mole H-atom

c) One H-atom

d) 1 mole H-atom

$C_{SD} = 5$

→ 1 mole = 6.022×10^{23} Number

→ 6.022×10^{23} Number = Avogadro's No.

→ N_0 or N_A = Represent

→ 7^{th} S.I Unit = Amount Ki

→ Jiska mole hoga = Usi ke number honge

→ yadi name ke pichhe atom or molecule nahi likha hai, Natural form ko consider kr ke chalna hai

→ 1 mole $A_xB_yC_z$ - - -

No. of mole of A-atom = x mole

No. of mole of B-atom = y mole

No. of mole of C-atom = z mole

No. of mole of total atom = (x+y+z) mole

$$\text{No. of mole} = \frac{\text{given No.}}{6.022 \times 10^{23}}$$

Number $\xrightarrow{\div N_A}$ Mole

Mole $\xrightarrow{\times N_A}$ Number

Q. 6.022×10^{20} molecule of $C_6H_{12}O_6$

Select Correct statements

a) 10^{-3} mole of glucose ✓

b) 6×10^{-3} mole of C-atom ✓

c) 12×10^{-3} mole of H-atom ✓

d) All Correct ✓

No. of mole of glucose $= \frac{6.022 \times 10^{20}}{6.022 \times 10^{23}}$

$= 10^{-3}$ mole

$C_6H_{12}O_6$

6 mole C → $10^{-3} \times 6$

12 mole H → $10^{-3} \times 12$

6 mole O

24 mole atom

Q 6.022×10^{20} molecules of glucose ($C_6H_{12}O_6$) contains No. of mole of e^- is

$_6C^{12}$ $_1H^1$ $_8O^{16}$

a) 180×10^{-3} mole

b) 90×10^{-3} mole

c) 45×10^{-3} mole

d) NONE ✓

$C_6H_{12}O_6$

No. of e^- in one molecule $= 6 \times 6 + 12 \times 1 + 6 \times 8$
$= 36$

$$\begin{array}{r} 36 \\ 12 \\ 48 \\ \hline 96 \end{array}$$

No. of mole of glucose $= \dfrac{6.022 \times 10^{20}}{6.022 \times 10^{23}}$

$= 10^{-3}$ mole

1 mole glucose $= 96$ mole e^-

10^{-3} mole glucose $= 96 \times 10^{-3}$ mole

Q 3.011×10^{23} atoms of He and 6.022×10^{22} atom of Ne present in a container. Calculate total number of mole of atoms.

A. 0.5 mole

B. 0.4 mole

C. 0.56 mole

D. 0.6 mole

$\rightarrow \dfrac{3.011 \times 10^{23}}{6.022 \times 10^{23}} = \dfrac{1}{2}$ mole He $= 0.5$ mole He atom

$\rightarrow \dfrac{6.022 \times 10^{22}}{6.022 \times 10^{23}} = \dfrac{10^{22}}{10^{23}} = \dfrac{1}{10} = 0.1$ mole Ne atom

$0.5 + 0.1 = 0.6$ mole

Q. 0.1 mole CO_2 gas present in a container, If 6.022×10^{21} molecules of CO_2, remove, calculate remaining mole of CO_2 gas in container.

A. 0.99

B. 0.09

C. 0.52

D. 0.65

$$\begin{array}{r} 0.10 \\ -\,0.01 \\ \hline 0.09 \end{array}$$

0.1 mole CO_2 — $\frac{6.022 \times 10^{21}}{6.022 \times 10^{23}}$ molecule =

$0.1\text{ mole} - \frac{1}{100}\text{ mole} \Rightarrow 0.10 - 0.01 = 0.09\text{ mole } CO_2$

$$\text{No. of mole} = \frac{\text{given Number}}{6.022 \times 10^{23}}$$

$$\text{No. of molecule} = \text{Mole} \times 6.022 \times 10^{23} = \text{Mole} \times N_A$$

→ Number $\xrightarrow{\div N_A}$ Mole

→ Mole $\xrightarrow{\times N_A}$ Number

→ $\text{Mole} = \dfrac{\text{Number}}{N_A}$

→ $\text{Mole} \times N_A = \text{Number}$

→ $\text{Number} = \text{Mole} \times N_A$

Q How many C atom present in 10 mole sucrose ($C_{12}H_{22}O_{11}$)

a) $10 \times N_A$

b) $10 \times N_A \times 12$ ✓

c) $12 \times N_A$

d) NONE

$C_{12}H_{22}O_{11}$

1 mole sucrose = 12 mole C atom

10 mole " " = 12×10 mole C-atom

$= 12 \times 10 \times N_A$ No. of C-atom

Q How many total No. of atoms present in 10^{-3} mole of H_3PO_4.

a) $8 \times N_A$ atoms

~~b)~~ $8 \times 10^{-3} \times N_A$ atoms

c) 8×10^{-3} atoms

d) NONE

$H_3PO_4 \Rightarrow$ 1 mole H_3PO_4

$= 3+1+4 = 8$ mole atom

10^{-3} mole $= 8 \times 10^{-3}$ mole atom

$8 \times 10^{-3} \times N_A$ atom

Q select the correct option, which have maximum No. of atoms.

CO_2

$= 3$ mole atom

a) 10^{-4} mole of $CO_2 = 3 \times 10^{-4}$ mole atom

b) 10^{-2} mole of $CO = 2 \times 10^{-2}$ mole atom =

c) 10^{-3} mole of $C_3O_2 = 5 \times 10^{-3}$ mole atom $= 0.5 \times 10^{-2}$

d) 10^{-4} mole of $C_2O = 3 \times 10^{-4}$ mole atom

THANK YOU !!

MANTHAN NEET 2025

CHEMISTRY

Mole concept

Lecture-6



Sarvesh Sir

Topic

mole

QSD -1. Calculate total number of atoms in 10 mole of $H_2S_6O_4$

$2+6+4=12$

(A) 120 No

(B) 12 No

(C) 10 No

(D) none

1 mole $H_2S_6O_4$ = 12 mole atom

10 mole — $= 12 \times 10$

$= 120$ mole atom

$= 120 \times N_0$

QSD -2. Which have max number of carbon atom in given example

C-atom

(A) 3mole C_2H_6 → 2 mole × 3 × N_A

(B) 3mole CH_4 → 1 mole × 3 × N_A

(C) 3mole C_3H_6 → 3 mole × 3 × N_A

(D) 1mole $C_{12}H_{16}$ → 12 mole × 1 × N_A

$\frac{2}{2}$

NO. of mole in term mass of substance (gram)

$a = b$
$a = c$
$\overline{\quad\quad\quad}$
$b = c$

1 mole = 6.022×10^{23} number
↓
Koi na Kai weight hoga

***

→ 1 mole Contains always —
- → Molecule = M.wt gram
- → Atom = A.wt gram

→ 6.022×10^{23} NO. Ka weight = M.wt gram or A.wt gram Vice-Versa

Q 6.022×10^{20} molecules of CO_2 gas Contains x gram mass

Calculate value of $x = ?$

a) 0.44g

✓ b) 0.044g

c) 44gram

d) 4.4gram

CO_2

$6.022\times10^{23} \longrightarrow 44\text{ gram}$

$1 \longrightarrow \dfrac{44}{6.022\times10^{23}}\text{ g}$

$6.022\times10^{20} \longrightarrow \dfrac{44}{6.022\times10^{23}} \times 6.022\times10^{20}$

$= 44\times10^{-3} = 0.044\text{g}$

$C_{SD} = 6$

→ 1 Mole Contains = 6.022×10^{23} Number

→ 1 Mole Contains mass = M.wt gram or A.wt gram

→ 6.022×10^{23} Number = M.wt gram or A.wt gram

→ Mass of single atom or molecule = $\frac{M.wt}{N_A}$ gram

→ No. of mole = $\frac{\text{Mass of subs. (gram)}}{\text{M.wt or A.wt}}$

→ Mass of subs. (gram) = Mole × M.wt or A.wt

Q 9.8 gram H_2SO_4

Calculate

a) mole of H_2SO_4 = $\frac{9.8}{98}$ = 0.1 mole = 10^{-1} mole

b) total No. of mole of O-atom = 4×10^{-1} mole

c) total No. of atoms = 7 mole $\times 10^{-1} \times N_A = 0.7 N_A$

d) total No. of H_2SO_4 molecule = $10^{-1} \times N_A = 0.1 N_A$

H_2SO_4

2+1+4=7

H_2SO_4

$2 \times 1 + 1 \times 32 + 4 \times 16$

= 98

H_2SO_4

1 mole H_2SO_4 = 4 mole

10^{-1} — 4×10^{-1} mole O-atom

Q Which have contains maximum No. of mole of molecules

$_{1}H^{1}$ $_{8}O^{16}$ $_{7}N^{14}$ $_{16}S^{32}$

✓ a) $4g\ H_2 \longrightarrow \frac{4}{2} = 2$ mole

b) $8g\ O_2 \longrightarrow \frac{8}{32} = \frac{1}{4}$ mole

c) $14g\ N_2 \longrightarrow \frac{14}{28} = \frac{1}{2}$ mole

d) $16g\ S_2 \longrightarrow \frac{16}{64} = \frac{1}{4}$ mole

Q. Which have contains maximum No. of atoms

a) $4g\ H_2 = \frac{4}{2} = 2\ mole\ H_2 = 4\ mole\ H\text{-atom} = 4 \times N_A$ ✓

b) $8g\ O_3 = \frac{8}{48} = \frac{1}{6}\ mole\ O_3 = 3 \times \frac{1}{6}\ mole\ O\text{-atom} = \frac{1}{2} \times N_A$

c) $14g\ N_2 = \frac{14}{28}\ mole = \frac{1}{2}\ mole\ N_2 = \frac{1}{2} \times 2\ N\text{-atom} = 1\ mole\ N\text{-atom} = 1 \times N_A$

d) $16g\ S_8 \rightarrow \frac{16}{8 \times 32} = \frac{1}{8 \times 2}\ mole\ S_8 = 8\ mole \times \frac{1}{16} = \frac{1}{2}\ mole\ S\text{-atom} = \frac{1}{2} \times N_A\ S\text{-atom}$

$S_8 = 32 \times 8$

Q Which have max. No. of O-atom

a) 8 gram O-atom $= \frac{8}{16}$ mole $= \frac{1}{2}$ mole O-atom $=$ $\boxed{\frac{1}{2} \times N_A \text{ O-atom}}$

b) 8 gram O_2 molecule $= \frac{8}{32} = \frac{1}{4}$ mole O_2 molecule $=$ 2 mole $\times \frac{1}{4} = \frac{1}{2}$ mole-O-atom $=$ $\boxed{\frac{1}{2} \times N_A \text{ O-atom}}$

c) 8 gram O_3 molecule $= \frac{8}{48} = \frac{1}{6}$ mole O_3 $=$ 3 mole $\times \frac{1}{6}$ mole O-atom $=$ $\frac{1}{2}$ mole O-atom $=$ $\boxed{\frac{1}{2} \times N_A \text{ O-atom}}$

d) All have same No. of O-atom ✓

1.28 Which one of the following will have the largest number of atoms?

(i) 1 g Au (s)

(ii) 1 g Na (s)

(iii) 1 g Li (s)

(iv) 1 g of Cl_2(g)

→ NEET-2024

Au = 196

Na = 23

Li → 7

Cl → 35.5, Cl_2 = 71

i) $\frac{1}{196}$ mole × N_A

ii) $\frac{1}{23} \times N_A$

(iii) $\frac{1}{7} \times N_A$

(iv) $\frac{1}{71}$ mole Cl_2 = 2 mole × $\frac{1}{71}$ = $\frac{2}{71}$ mole Cl-atom = $\frac{2}{71} \times N_A$

1.10 In three moles of ethane (C_2H_6), calculate the following:

(i) Number of moles of carbon atoms.

(ii) Number of moles of hydrogen atoms.

(iii) Number of molecules of ethane.

3 Mole C_2H_6

i) No. of mole of C-atom = 2×3 = 6 mole

ii) No. of mole of H-atom = 6×3 = 18 mole

iii) No. of molecule of ethane = $3 \times N_A$

1.33 Calculate the number of atoms in each of the following (i) 52 moles of Ar (ii) 52 u of He (iii) 52 g of He.

total No. of atoms in each of the following

i) 52 mole of Ar = $52 \times N_A$ Ar-atom

Avg. At. wt

ii) 52 u of He

iii) 52 gram He = $\frac{52}{4}$ mole = $\frac{52}{4} \times N_A$ He-atom

Q5. The number of water molecules is maximum in [CBSE AIPMT 2015]

(a) ✗ 18 molecules water (b) ✗ 1.8g of water

(c) 18g of water (d) ✓ 18 moles of water

(b) $\frac{1.8}{18}$ mole = 0.1 mole H_2O → $0.1 \times N_A$

(c) $\frac{18}{18}$ = 1 mole water = $1 \times N_A$ No. of H_2O

(d) $18 \times N_A$ No. of H_2O

Q22. Which has maximum number of molecules? **[CBSE AIPMT 2002]**

(a) 7g N_2 (b) 2g H_2

(c) 16g NO_2 (d) 16g O_2

14+32

a) $\frac{7}{28}$ mole N_2 = $\frac{1}{4}$ mole N_2 = $\frac{N_A}{2}$ molecule of N_2

b) $\frac{2}{2}$ mole H_2 = 1 mole H_2 = $1 \times N_A$ molecule of H_2

c) $\frac{16}{46}$ mole NO_2 = 0.35 mole NO_2 = $0.35 \times N_A$

d) $\frac{16}{32}$ mole O_2 = $\frac{1}{2}$ mole O_2 = $\frac{1}{2} \times N_A$

Q26. The number of atoms in 4.25 g of NH_3 is approximately

[CBSE AIPMT 1999]

(a) 4×10^{23} (b) 2×10^{23}

(c) 1×10^{23} (d) 6×10^{23}

H.W.

Q37. The number of oxygen atoms in 4.4 g of CO_2 is [CBSE AIPMT 1990]

(a) 1.2×10^{23} (b) 6×10^{22}

(c) 6×10^{23} (d) 12×10^{23}

H.W.

Q. The weight of carbon monoxide in 6.02×10^{24} CO molecules is

(a) 28g (b) 50g

(c) 280g (d) 0.5g

$12 + 16 = 28$

6.022×10^{23} No. of CO = M.wt gram = 28 gram

$1 \longrightarrow \frac{28}{6.022 \times 10^{23}}$ g

$6.02 \times 10^{24} \longrightarrow \frac{28}{6.022 \times 10^{23}} \times 6.02 \times 10^{24}$ (10)

= 280 gram

M-2

Mole of CO $= \frac{6.02 \times 10^{24}}{6.022 \times 10^{23}}$

= 10 mole

$W_{CO} = 10 \times 28$ g

= 280 gram

Q 1.2 gram C atom form, How many mole of C_2H_6 (ethane)

$\frac{1.2}{12} = 0.1$ mole C-atom

a) 0.5 mole

b) 0.05 mole ✓

c) 0.1 mole

d) NONE

M-2

1 mole C_2H_6 = 2 mole

x mole C_2H_6 = 2x mole C-atom

$2x = 0.1$

$x = \frac{0.1}{2} = 0.05$ mole

1 mole C_2H_6 = 2 mole C-atom

2 mole C-atom = 1 mole

1 ——— $\frac{1}{2}$ mole

0.1 ———→ $\frac{1}{2} \times 0.1 = \frac{0.1}{2} = 0.05$ mole

THANK YOU !!

MANTHAN NEET 2025

CHEMISTRY

Mole concept

Lecture-7



Sarvesh Sir

Topic

mole

Qsd -1. mass of 1 drop water is 1.8 mg , than calculate moles of water in 10 drop of water

(a) 0.001mole (b) 0.01mole

(c) 0.0001mole (d) 0.1mole

$$1\,drop = 1.8 \times 10^{-3}\,gram$$

$$10\,drop = 1.8 \times 10^{-3} \times 10\,g$$

$$= 18 \times 10^{-3}\,g$$

$$mole\ of\ H_2O = \frac{18 \times 10^{-3}}{18} = 10^{-3}\,mole = 0.001\,mole$$

Qsd-2 1.33 Calculate the number of atoms in each of the following (i) 52 moles of Ar (ii) 52 u of He (iii) 52 g of He.

X

total No. of atoms in each of the following

i) 52 mole of Ar = $52 \times N_A$ No. of Ar-atom

(iii) 52 gram He = $\frac{52}{4}$ mole of He = $\frac{52}{4} \times N_A$ No. of He atom

$\frac{?}{2}$

Mole in term of volume of Gas

ideal gas → $PV = nRT$

$$n = \frac{PV}{RT}$$

<u>where</u>

P = Pressure of gas (atm)

V = Volume of gas (litre)

T = temperature (K)

R = Gas Constant = 0·0821 atm·litre·mole^{-1}, K^{-1}

n = No·of mole of Gas

* only applicable for gas

$$V = \frac{nRT}{P} \simeq 22.4 \text{ Litre}$$

$T = 0^\circ C = 273K$

$P = 1atm$

$R = 0.0821$

$n = 1Mole$

1 mole ideal gas occupied = 22.4 litre volume at 273 K temp. and 1 atm pressure.

S.T.P. = standard temperature (273 K) and pressure (1 atm)

$T = 273K$

$P = 1atm$

1 mole ideal gas = 22.4 litre at S.T.P.

2 mole = 22.4×2 Litre at S.T.P.

$\frac{1}{2}$ mole = $\frac{22.4}{2}$ Litre at S.T.P.

$C_{SD} = 7$ $PV = nRT$

→ No. of mole of ideal gas (n) = $\frac{P \times V}{R \times T}$ (only applicable for gas)

P (atm), V (litre), T (K)

R = 0.0821 atm × litre × mole⁻¹ × K⁻¹

→ 1 mole ideal gas occupied = 22.4 litre at S.T.P.

S.T.P. ⇒ Standard temp. (273K) & pressure (1atm)

Volume of gas at S.T.P. = 22.4 × No. of mole of gas (litre)

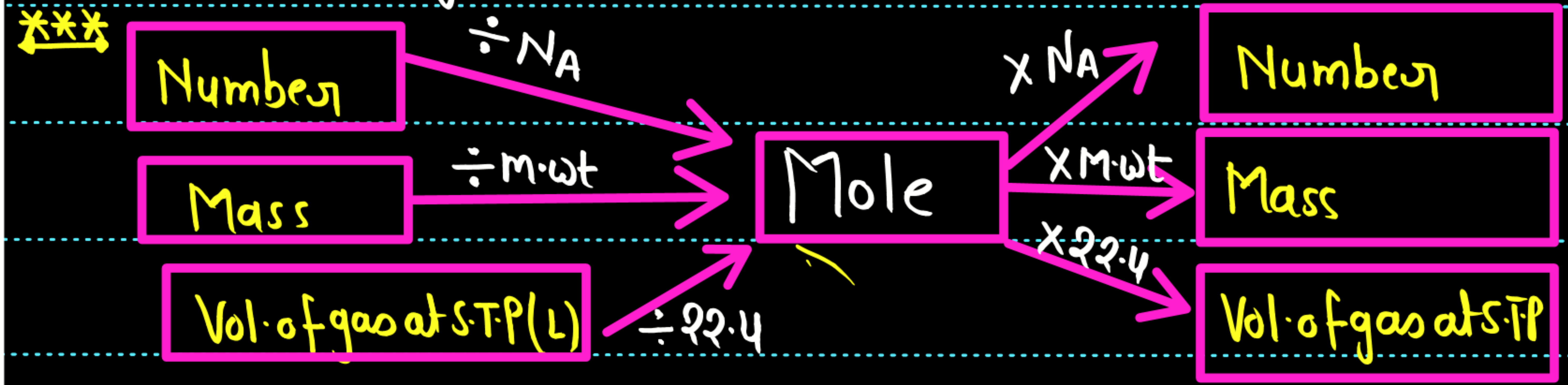
*** → No. of mole ideal gas = $\frac{\text{Volume of gas at S.T.P (litre)}}{22.4}$

[Jab volume of gas at S.T.P. = given ho T = 273 K, P = 1 atm)

Note → Mole in term of volume of liquid

$$(\text{Mass})_{\text{liquid}} = \text{Volume} \times \text{density}$$

Water ⇒ density = 1 gm/ml



Q → Volume of water at S.T.P. is 18 ml. Calculate No. of mole of water.

a) 10^{-3} mole

b) 1 mole ✓

c) 10^{3} mole

d) $\frac{18 \times 10^{-3}}{22.4}$ mole

S.T.P = T = 273 = 0°C

Water = liquid

Mass of water = $(Vol.)_{H_2O} \times d_{H_2O}$

$= 18\,\cancel{ml} \times 1 \frac{g}{\cancel{ml}} = 18$ gram

No. of mole of water $= \frac{18}{18} = 1$ mole

Q → 22 gram CO_2 gas Contains volume at S.T.P. is

a) 22.4 L

✓ b) 11.2 L

c) 44.8 L

d) 5.6 L

Mole of $CO_2 = \frac{22}{44} = \frac{1}{2}$ mole

Vol. of CO_2 at S.T.P = $22.4 \times \frac{1}{2} = \underline{11.2 L}$

Q Select the correction option which have Contains maximum number of molecules

a) 22.4 ml of CO_2 at S.T.P. $= \frac{22.4 \times 10^{-3} L}{22.4} = 10^{-3}$ mole $= 10^{-3} \times N_A$

b) 1 gram H_2 gas. $= \frac{1}{2}$ mole H_2 $= \frac{1}{2} \times N_A$

c) 6.022×10^{20} molecule of O_2 $= \frac{6.022 \times 10^{20}}{6.022 \times 10^{23}}$ mole $= 10^{-3}$ mole $= 10^{-3} \times N_A$

d) 18 ml of H_2O at S.T.P. $= 18 ml \times 1 \frac{g}{ml} = 18$ gram $= \frac{18}{18} = 1$ mole $= 1 \times N_A$

liquid T=273K

$M = V \times d$

Atomic Mass = Mass of single atom of subtances

Atomic Mass Number = sum of No. of proton and neutron in single atom.

N_A (6.022×10^{23}) No. of atom = Atomic Mass No. in gram.

N_A No. of molecule = Molecular Mass in gram

$$1 \text{ atom} = \frac{\text{Atomic Mass}}{N_A}$$

$$1 \text{ molecule} = \frac{\text{Molecular wt.}}{N_A}$$

Q → Calculate Atomic mass of Carbon atom.

a) 12 gram.

b) $\frac{12}{N_A}$ gram ✓

Mass of single atom of Carbon = $\frac{12}{N_A}$ gram

Mass of single C-atom = $12 \times \frac{1}{N_A}$ gram

= 12 amu = 12u

1 amu = Atomic Mass unit

or

1u = Unified

1 amu = $\frac{1}{N_A}$ gram

Mass of N_A (6.022×10^{23}) atom = Atomic mass in gram = 12 gram

Mass of single C atom = $\frac{A.wt}{N_A}$ g = $\frac{12}{N_A}$ g = 12 amu = 12 u

Ex → 16 u of oxygen

a) Mass of single O-atom ✓✓

b) Mass of N_A O-atom

$C_{SD} = 8$

Atomic Mass → Mass of single atom = $A\,\mu$ = A amu = $\frac{A}{N_A}$ gram

Atomic Mass Number (A) = Sum of No. of proton + No. of neutron in single atom ($A = p + n$)

→ 1 atomic Mass unit = 1 unified = $\frac{1}{N_A}$ gram = 1.66×10^{-24} gram

→ **Molar Atomic Mass** = Mass of 1 mole atom = A gram

→ **Gram Atomic Mass or Gram Atom** = Mass of Atom in gram = A gram

Q Select the Correct atomic mass of Carbon atom.

a) 12 → Atomic Mass No. single atom ka mass

b) 12 gram → Mass of 1 mole = N_A No. of atom

✓ c) 12 u → single atom ka mass

d) All

List-1 (for O-atom)		List-2
a) Atomic Mass	→ r	p) 16
b) Molar Atomic Mass	→ q	q) 16 gram
c) Atomic Mass Number	→ p	r) 16 u
d) Gram atomic Mass	→ q	s) 8 gram

Relative Atomic Mass (R.A.M.)

THANK YOU !!

MANTHAN NEET 2025

CHEMISTRY

Mole concept

Lecture-8



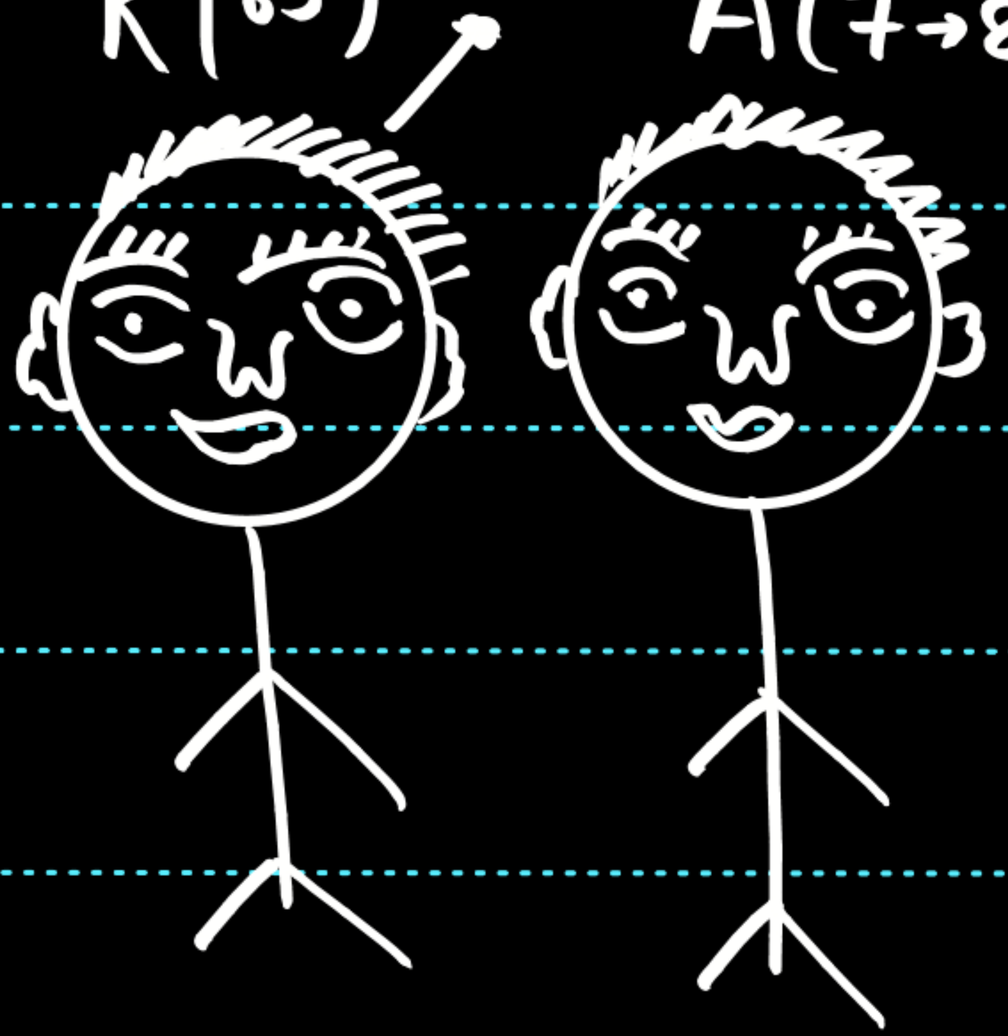
Sarvesh Sir

Batch + test = 430 → 480

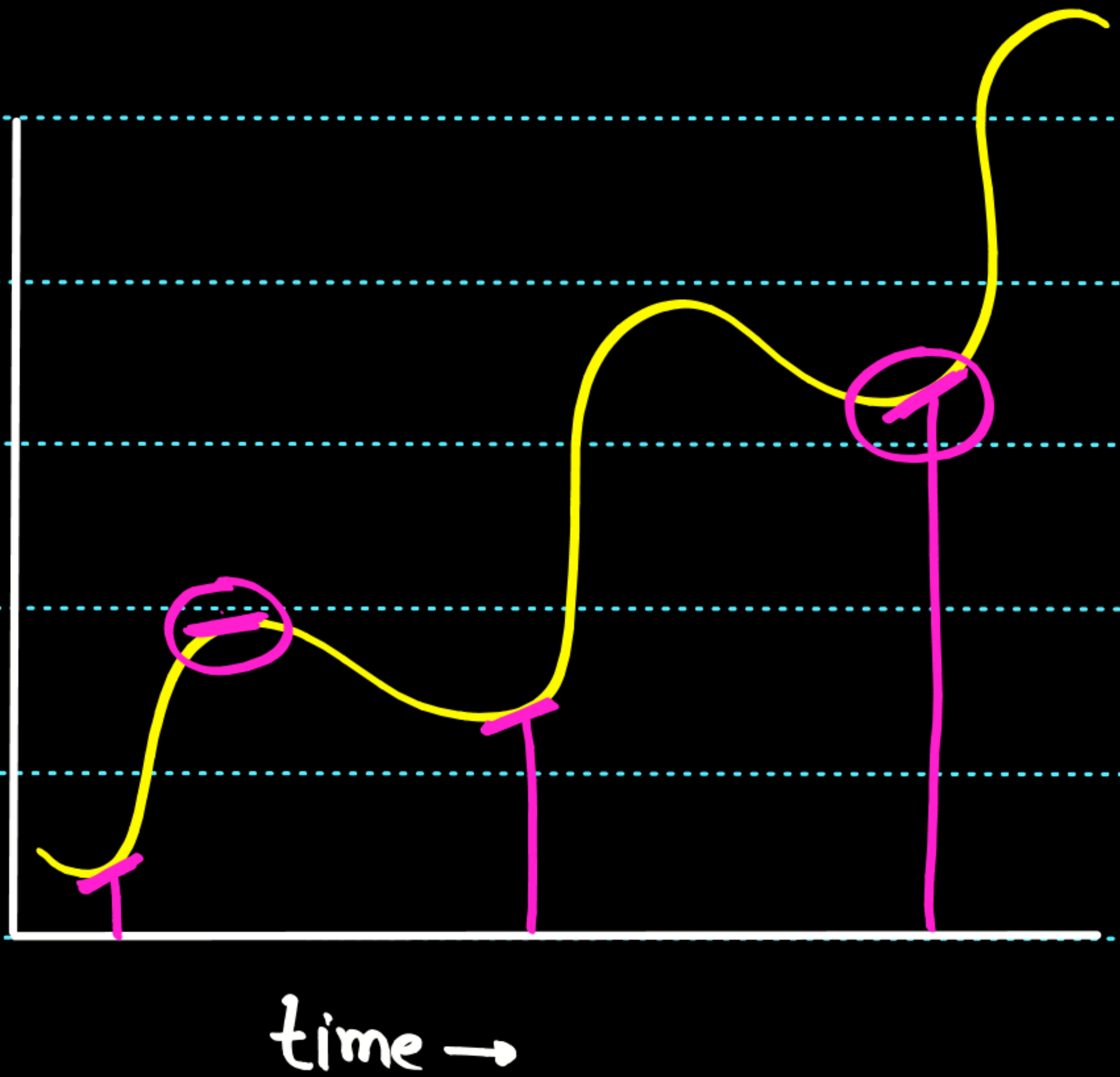
640 (NBTs) initial stest

428

R(65) A(7→8)



↑ preparation



Topic

mole

QSD -1. Calculate total mole of 1.8 litre of water

(A) 0.1 mole

(B) 0.2 mole

(C) 1 mole

(D) none

liquid

$\frac{1.8}{22.4}$ (gas)

$M = V \times d$

$M = 1.8 \text{ Litre} \times 1 \frac{g}{ml}$

$= 1.8 \times 1000 \text{ ml} \times 1 \frac{g}{ml}$

$= 1800 \text{ gram}$

$\text{Mole} = \frac{1800}{18}$

$= 100 \text{ mole}$

QSD -2. Which have max number of carbon atom in given example

$\frac{24}{6}$

Molecule | C-atom

(A) 16 gram $C_2H_6 = \frac{16}{30} = \frac{8}{15}$ mole $= \frac{8}{15} \times N_A$ — $\frac{8}{15} \times 2 \times N_A = \frac{16}{15} N_A$

(B) 16 gram $CH_4 \rightarrow \frac{16}{16} = 1$ mole $\rightarrow 1 \times N_A$ = $1 N_A \times 1 = N_A$

(C) 2.24 litre of C_3H_6 gas at STP $\rightarrow \frac{2.24}{22.4} = 0.1 \times N_A$ — $0.1 \times 3 \times N_A = 0.3 N_A$

(D) 1mole $C_{12}H_{16}$ ✓

↳ 1mole $\times N_A \Rightarrow 12 \times 1 \times N_A = 12 N_A$

$\frac{?}{?}$

Relative Atomic mass (R.A.M.)

Sarvesh yadav $C\frac{70}{10} = ⑦$

$$R.A.M = \frac{\text{Mass of single atom}}{\text{Mass of 1amu}} = \frac{(\text{Mass})_{\text{single atom}}}{\frac{1}{N_A}\text{ gram}}$$

$\left(\frac{12}{N_A}\right)$

$$R.A.M. = \frac{(\text{Mass})_{\text{single atom}}}{\frac{1}{12} \times \frac{12}{N_A}\text{ gram}} = \frac{(\text{Mass})_{\text{single atom}}}{\frac{1}{12} \times \text{Mass of single atom C-12 isotope}}$$

R·A·M → unitless quantity

R·A·M → number.

R·A·M = 'A' (Mass Number)

Q → Calculate mass of single atom of 'C'

a) $\frac{12}{N_A}$ g

b) $\frac{1}{N_A}$ g

c) 12 gram

d) NONE

single atom $= \frac{A \cdot wt}{N_A} = \frac{12}{N_A}$ gram

$= 12 \times \frac{1}{N_A}$ gram

$= 12 u$

Q– Select the correct Relative atomic mass of oxygen atom.

↳ A

$^{16}_{8}O$ (16 → A, 8 → Z)

a) 16 u

b) 16 gram

c) 16 //

d) All

C_{SD}

$1\ amu = 1\mu = \frac{1}{N_A} g = 1.66 \times 10^{-24}$ gram

→ Atomic Mass Number (A) = No. of proton + No. of neutron

→ Atomic Mass = Mass of single atom $= \frac{A}{N_A}$ gram $= A\mu$ or A amu

→ Gram Atomic wt. or Molar Atomic wt = Mass of 1 mole of Atom = A gram

→ Relative Atomic Mass $= \frac{(\text{Mass})_{\text{single atom}}}{\frac{1}{12} \times \text{Mass of single Carbon (12)}} =$ 'A'

Average atomic Mass $= \frac{\Sigma A_i x_i}{\Sigma x_i} = \frac{A_1 x_1 + A_2 x_2 + A_3 x_3 - - -}{x_1 + x_2 + x_3 + - -}$

① → $A_{min.} < Avg < A_{max}$

② → Avg. Atomic wt Ki value, uske pas me hoti hai, Jiska abundance % Jada hota hai

x_1, x_2, x_3 — —

= % of abundance

= mole of isotope

= No. of isotope

1.33 Calculate the number of atoms in each of the following (i) 52 moles of Ar (ii) 52 u of He (iii) 52 g of He.

Calculate the number of atoms in each of the following

52 u of He

Sol^n ⇒ $\text{Mole} = \frac{\text{wt. (gram)}}{\text{A.wt}} = \frac{52 \times \frac{1}{N_A}\text{ gram}}{4} = \frac{13}{N_A}\text{ mole He-atom}$

$= \frac{13}{N_A} \times N_A = 13 \text{ atom of He}$

Average Atomic Mass

→ Mostly → having isotope

→ H-atom → $_1H^1$ → protrium − 99%
$_1H^2$ → Deuterium = 0.01%
$_1H^3$ → Titrium → 10^{-15}%

A → atom isotopes	ab.	= total
A_1 →	x_1%	= A_1x_1
A_2 →	x_2%	= A_2x_2
A_3 →	x_3%	= A_3x_3
⋮	⋮	

total Mass = $A_1x_1 + A_2x_2 + \ldots$

$$\text{Avg. Atomic Mass} = \frac{\sum A_i x_i}{\sum x_i} = \frac{A_1x_1 + A_2x_2 + A_3x_3 + \ldots}{x_1 + x_2 + x_3 + \ldots}$$

ATOMIC MASS

Atomic mass of an element can be defined as the number which indicates how many times the mass of one atom of the element is heavier in comparison to $\frac{1}{12}$th part of the mass of one atom of Carbon-12.

$$Atomic\ mass = \frac{[Mass\ of\ an\ atom\ of\ the\ element]}{\frac{1}{12} \times [Mass\ of\ an\ atom\ of\ carbon-12]} = \frac{Mass\ of\ an\ atom\ in\ amu}{1\ amu}$$

Q38. Boron has two stable isotopes, ^{10}B (19%) and ^{11}B(81%). Calculate average atomic weight of boron in the periodic table: [CBSE AIPMT 1990]

(a) 10.8 ✓ (b) 10.2 ✗

(c) 11.2 ✗ (d) 10.0 ✗

① $10 < \text{Avg} < 11$

②

Sol^n →

$$\text{Avg.} = \frac{A_1X_1 + A_2X_2 + A_3X_3 + \cdots}{X_1 + X_2 + X_3 + \cdots}$$

$$= \frac{10\times19 + 11\times81}{19+81} = \frac{190+891}{100} = \underline{\underline{10.8}}$$

iron and oxygen are 69.9 and 30.1, respectively.

1.9 Calculate the atomic mass (average) of chlorine using the following data:

	% Natural Abundance	**Molar Mass**
^{35}Cl	75.77	34.9689
^{37}Cl	24.23	36.9659

1.10 In three moles of ethane (C_2H_6), calculate the following:

(A) 35

(B) 37.2

(C) 35.5

(D) 36.5

1.32 Use the data given in the following table to calculate the molar mass of naturally occuring *argon* isotopes:

Isotope	Isotopic molar mass	Abundance
^{36}Ar	35.96755 g mol^{-1}	0.337%
^{38}Ar	37.96272 g mol^{-1}	0.063%
^{40}Ar	39.9624 g mol^{-1}	99.600%

H.W.

Q17. An element, X has the following isotopic composition:

^{200}X : 90%, ^{199}X : 8.0%, ^{202}X : 2.0%

The weighted average atomic mass of the naturally occurring element X is closest to [CBSE AIPMT 2007]

(a) 201 u (b) 202 u

(c) 199 u (d) 200 u

→ 199 < Avg < 202

→

Molecular Mass = sum of Atomic mass of Atom present in one molecule.

→ Molecular Mass = sum of Atomic Mass

Ex → H_2O = 2 H-atom + 1 O-atom

Molecular Mass = $2 \times A_H + 1 \times A_O = 2 \times 1 + 1 \times 16 = 2 + 16 = \underline{18}$

Ex → $H_2SO_4 = 2H + 1 \times S + 4 \times O = 2 \times 1 + 1 \times 32 + 4 \times 16$

$= 2 + 32 + 64 = \underline{98}$

13:3

Q - Calculate molecular Mass of $C_6H_{12}O_6$ (glucose)

a) 180

b) 90

c) 160

d) NONE

$6C + 12H + 6O$

$6 \times 12 + 12 \times 1 + 6 \times 16$

$= 180$

CSD

Molecular Mass = Mass of single molecule = $\frac{M}{N_A}$ g = M amu or = M μ

Where → M = Molecular Mass Number

Gram Molecular wt. or Molar wt of molecule = Mass of 1 mole

= M gram

Relative Molecular wt. = $\frac{\text{Mass of single molecule}}{\frac{1}{12} \times \text{Mass of single C-12 isotopes}}$ = M

Average Molecular Mass ⇒ $M_{avg} = \frac{M_1X_1 + M_2X_2 + ---}{X_1 + X_2 + X_3 - -}$

where → M_1, M_2, M_3 = M·wt of molecule in mixture

X_1, X_2, X_3 --- = % of Molecules, or mole of molecules

→ Mass of 1 mole molecule = M·wt gram

→ N_A number = M·wt gram = 22.4 litre at S.T.P. (gas)

M·wt = sum of Atomic Mass

Ex → $A_x B_y$

Moleculor Mass of $A_x B_y$ = $x \times A_A + y \times A_B$

Q → Molecular Mass of water (H_2O) is.

a) 18u ✓✓

b) 18

c) 18 gram

d) All

2. The formula of an acid is HXO_2. The mass of 0.0242 moles of the acid is 1.657 g. What is the atomic weight of X?

(a) 35.5 (b) 28.1

(c) 128 (d) 19.0

0.0242 mole = 1.657 g

$1 \text{ mole} = \frac{1.657}{0.0242}$

1 mole = 68.47 ≃ 68.5

HXO_2

$M.wt = A_H + A_X + 2 \times A_O$

$68.5 = 1 + A_X + 2 \times 16$

$A_X = 35.5$

Q1. Suppose the elements X and Y combine to form two compounds XY_2 and X_3Y_2. When 0.1 mole of XY_2 weighs 10g and 0.05 mole of X_3Y_2 weighs 9g, the atomic weights of X and Y are **[NEET 2016]**

(a) 40, 30 (b) 60, 40

(c) 20, 30 (d) 30, 20

$X + Y \rightarrow \begin{cases} XY_2 = 0.1\,\text{mole} = 10\,g \Rightarrow 1\,\text{mole} = \frac{10}{0.1} = 100\,\text{gram} \\ X_3Y_2 - 0.05\,\text{mole} = 9\,\text{gram} \Rightarrow 1\,\text{mole} = \frac{9}{0.05} = 180\,\text{gram} \end{cases}$

$A_x + 2A_y = M.wt = 100$

$- 3A_x + 2A_y = M.wt = 180$

$+2A_x = +80 \Rightarrow A_x = 40$

8. 2 mole of CO_2 gas and 3 mole of SO_3 gas present in a container. Calculate M. wt. of gas mixture?.

44 80

$$Sol^n = M_{avg} = \frac{M_1 X_1 + M_2 X_2}{X_1 + X_2}$$

$$= \frac{44 \times 2 + 80 \times 3}{2+3}$$

$$= \frac{88+240}{5} = \frac{328}{5} = 65.6$$

THANK YOU !!

MANTHAN NEET 2025

CHEMISTRY

Mole concept

Lecture-9



Sarvesh Sir

Topic

Empirical formula

molecular formula

QSD -1 . 0.01 mole of compound x contains 2 gram , calculate molecular weight of compound X

(A) 100

(B) 200 ✓

(C) 10

(D) none

1 mole = M.wt gram

0.01 mole = 2g

$$1\text{ mole} = \frac{2}{0.01} = 200\text{g}$$

M.wt of Comp. X = 200g

Qsd -2 Boron has two stable isotopes, ^{10}B (90%) and ^{11}B(10%). Calculate average atomic weight of boron in the periodic table

(A) 9.5

(B) 11.2

(C) 10.5

(D) 10.10

→ $A_{min} < Avg < A_{max}$

$$\frac{10 \times 90 + 11 \times 10}{90 + 10} = \frac{900 + 110}{100} = \frac{1010}{100} = 10.10$$

Density and vapour density

Density

- **Absolute density**
- **Vapour density**

Absolute density

$$\text{density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{unit} = \frac{Kg}{m^3} \text{ or } \frac{g}{ml}$$

Vapour density

$$V.D. = \frac{\text{Molecular weight}}{2} = \frac{M.wt\ g}{2\ g}$$

Unit = unitless quantity

$$(V.D.)_{gas} = \frac{(M.wt)_{gas}}{2}$$

$$(V.D.)_{Avg} = \frac{(M.wt)_{Avg}}{2} = \frac{(M.wt)_{gas\ mixture}}{2}$$

CSD

density = $\frac{\text{Mass}}{\text{Volume}}$

Unit = $\frac{g}{ml}$ or $\frac{kg}{m^3}$

V.D = $\frac{\text{M.wt}}{2}$

Unitless quantity

$(V.D)_{gas} = \frac{(\text{M.wt})_g}{2}$

$(V.D)_{Avg} = \frac{(\text{M.wt})_{Avg}}{2} = \frac{(\text{M.wt})_{\text{gas mixture}}}{2}$

→ $(\text{M.wt})_{Avg} = 2 \times (V.D)_{Avg}$

→ $(\text{M.wt})_{Avg} = \frac{m_1x_1 + m_2x_2}{x_1 + x_2}$

→ % of element = $\frac{\text{total Mass of element}}{\text{Mass of Compound}} \times 100$

→ % of atom in compound is fixed (constant), not depend upon amount of compound. only depend arrangement of atom in Compound.

→ % de Kr, Question me Kuch bhi puchh Jaye, Aap alway % of element wale formula Ko put Krne Ki Koshish Krna.

→ Minimum Molecular wt. → Calculate Karo ⇒ It means, wo atom Us Compound me 1 hai

10. The vapour density of a mixture containing NO_2 and N_2O_4 is 38.3 at 270°C. Calculate the moles of NO_2 in 10 moles mixture.

(a) 3.34 mole
(b) 7 mole
(c) 6 mole
(d) None of these

x mole

$14+32=$

$(10-x)$

$(V.D)_{Avg}$

$(M.wt)_{Avg} = 2 \times (V.D)_{Avg}$

$= 2 \times 38.3$

$= 76.6$

$$(M.wt)_{Avg} = \frac{m_1 x_1 + m_2 x_2}{x_1 + x_2}$$

$$76.6 = \frac{46 \times x + 92(10-x)}{x + 10 - x}$$

$766 = 46x + 920 - 92x$

$766 - 920 = -46x$

$+154 = +46x$

$x = 3.34$ mole

Q → Calculate vapour density of SO_3 gas

a) 40g

b) 40 ✓

c) 80

d) 80g

$$V.D. = \frac{M.wt}{2} = \frac{80}{2} = 40$$

Percentage of atom or molecule in given Compound

Ex → $H_2O = 2H + 1 O$ ⇒ M.wt of $H_2O = 18$

→ % of O in water $= \frac{1 \times 16}{18} \times 100 = \frac{800}{9} = 88.88\%$

→ % of H in water $= \frac{2 \times 1}{18} \times 100 = \frac{100}{9} = 11.11\%$

Ex → NaCl = % of $Na^+ = \frac{23}{58.5} \times 100$

% of $Cl^- = \frac{35.5}{58.5} \times 100$

Q → 10 gram water contains 11.11 % of H-atom.

If mass of water taken double (20 gram). than

findout % of H-atom in final water

a) 11.11 //

b) 22.22

c) 5.75

d) NONE

Q Percentage of Se in peroxidese anhydrase enzyme is 0.5% by weight (at weight = 78.4), then minimum molecular weight of peroxidise anhydrase enzyme is [CBSE AIPMT 2001]

(a) 1.568×10^3 (b) 15.68

(c) 2.168×10^4 (d) 1.568×10^4

$$\%\text{ of Se} = \frac{\text{total Mass of Se}}{\text{M.wt of enzyme}} \times 100$$

$$0.5 = \frac{1 \times 78.4}{\text{Mwt}} \times 100$$

$$\text{M.wt} = \frac{78.4}{0.5} \times 100 = 15700$$

Q. Haemoglobin contains 0.33% of iron by weight. The molecular weight of haemoglobin is approximately 67200g. The number of iron atoms (at. Weight of Fe is 56) present in one molecule of haemoglobin are

56

[CBSE AIPMT 1998]

(a) 1 (b) 6

(c) 4 (d) 2

$$\% \text{ of Fe} = \frac{\text{total Mass of Fe}}{\text{M.wt of Hb}^{m}} \times 100$$

$$0.33 = \frac{x \times 56}{67200} \times 100$$

$$x = 4$$

Q33. The percentage weight of Zn in white vitriol [$ZnSO_4.7H_2O$] is approximately equal to (at. mass of Zn = 65, S = 32, O = 16 and H = 1).

[CBSE AIPMT 1995]

(a) 33.65%	(b) 32.56%

(c) 23.65%	(d) 22.65%

H.W.

Q. Percentage of oxygen in carbon oxide (C_3O_x) is 47.05%, calculate the value of x

$3\times12+x\times16$

$36+16x$

C_3O_2

A 1

B 4

C 6

D 2

$$\% \text{ of } O = \frac{\text{total Mass of O-atom}}{\text{M.wt of comp.}} \times 100$$

$$47.05 = \frac{x\times16}{36+16x}\times100$$

$$47.05\times36 + 47.05\times16x = 1600x$$

$$x=2$$

Empirical formula → Minimum | simplest | molar ratio

Smallest whole no. mole Ka ratio
of atom in a molecule.

$$\text{Mole} = \frac{\text{Mass\%}}{\text{A.wt}} \text{ or } \frac{\text{Mass}}{\text{A.wt}} \text{ or } \frac{\text{Number}}{N_A}$$

Q → Comp-X Contains H = 2 gram and oxygen = 8 gram
Calculate E.F. of Comp. a) H_2O_3 b) H_2O c) H_2O_2 d) NONE ✓

$$H : O$$
$$\frac{2}{1} : \frac{8}{16} \Rightarrow \frac{2 : \frac{1}{2}}{2} \Rightarrow 4:1 \rightarrow H_4O$$

Q. Determine the empirical formula of an oxide of iron which has 69.9% iron and 30.1% oxygen by mass.

A Fe_2O_3

B Fe_3O_4

C Fe_4O_3

D FeO

Fe_2O_3

F : O

$\frac{69.9}{56}$ $\frac{30.1}{16}$

$\frac{1.25}{1.25} : \frac{1.88}{1.25}$

$(1 : 1.5) \times 2 \Rightarrow 2 : 3$

Fe : O

2 : 3

Q. A Compound contains 32.4% carbon, 5.4% Hydrogen, 43.2% Oxygen and 19% Nitrogen by mass. Empirical formula of compounds is

A $C_3H_6N_2O_3$

B $C_4H_8N_2O_6$

C $C_2H_4N_1O_2$ ✓ $C_2H_4N_1O_2$

D $C_2H_4N_2O_4$

C : H : N : O

$\frac{32.4}{12}$ $\frac{5.4}{1}$ $\frac{19}{14}$ $\frac{43.2}{16}$

$\frac{2.7}{1.35}$ $\frac{5.4}{1.35}$ $\frac{1.35}{1.35}$ $\frac{2.7}{1.35}$

2 : 4 : 1 : 2

Molecular formula

Actual or Real simplest molar ratio of atom in a molecule

Ex → H_2O_2 ⟶ H_1O_1 → E.F. ⇒ M.F = 2 × E.F.

Real or actual

C_6H_6 ⟶ C_1H_1 ⇒ M.F = 6 × E.F

H_2O ⟶ H_2O ⇒ M.F = 1 × E.F

M.F (under the first H_2O); E.F (under the second H_2O)

M.F = n × E.F

n → 1, 2, 3, 4 - - - -

$$M.F = n \times E.F.$$

$$n = \frac{M.F.}{E.F} = \frac{\text{Mass of Molecular formula}}{\text{Mass of empirical formula}}$$

CSD

Empirical formula → Minimum, simplest molar ratio of atom

Molecular formula Actual or Real simplest molar ratio of atom

$$\eta = \frac{\text{Mass of Molecular formula}}{\text{Mass of Empirical formula}}$$

→ M.F = η × E.F.

→ Mass of 1 mole = M.wt gram

→ Vol. of gas at S.T.P. ⇒ 22.4 L Contains wt = M.wt gram

Q. Hydrocarbon contains C = 92.3% and H = 7.7% approx. Calculate Empirical formula of Hydrocarbon. If molecular weight of Hydrocarbon is 78, than find out molecular formula

Solⁿ → E.F. = C : H

$$= \frac{92.3}{12} : \frac{7.7}{1}$$

$$= 7.7 : 7.7$$

$$= 1 : 1$$

$$E.F. = C_1H_1 \rightarrow 12 + 1 = 13$$

$$n = \frac{\text{Mass of M.F.}}{\text{Mass of E.F.}} = \frac{78}{13} = 6$$

$$M.F. = 6 \times (C_1H_1)$$

$$= C_6H_6$$

Q. A welding fuel gas contains carbon and hydrogen only. Burning a small sample of it in oxygen gives 3.38 g carbon dioxide. 0.690 g of water and no other products. A volume of 10.0 L (measured at STP) of this welding gas is found to weigh 11.6 g . The empirical formula, molar mass of the gas and molecular formula will be respectively.

(A) CH_2, 30, C_2H_4

(B) CH, 26, C_2H_2 ✓ (24+2 = 26)

(C) CH, 30, C_2H_4

(D) CH_2, 26, C_2H_4 (24+4 = 28)

→ 22.4 L at S.T.P. = M.wt gram

10 L = 11.6 g

$22.4 L = \frac{11.6}{10} \times 22.4 = 26$

ARJUNA

THANK YOU !!

MANTHAN NEET 2025

CHEMISTRY

Mole concept

Lecture-10



Sarvesh Sir

Topic

Empirical formula

molecular formula

Qsd-01 Percentage of Nitrogen and Oxygen in nitrogen oxide (N_xO_y) are 26% and 74 % respectively , calculate the value of X+Y

A 7

B 6

C 4

D 2

N_2O_5

$x = 2$

$y = 5$

$x + y = 7$

N	O
$\frac{26}{14}$	$\frac{74}{16}$
$\frac{1.85}{1.85}$	$\frac{4.625}{1.85}$
1	2.5

$(1 \quad 2.5) \times 2 = 2 : 5$

Qsd-2 **Problem 1.2**

A compound contains 4.07% hydrogen, 24.27% carbon and 71.65% chlorine. Its molar mass is 98.96 g. What are its empirical and molecular formulas?

M.wt

12
2
35.5
49.5

→ NEET-2024

(A) EF = ?

(B) MF = ?

(C)

(D)

C	H	Cl
$\frac{24.27}{12}$	$\frac{4.07}{1}$	$\frac{71.65}{35.5}$
$\frac{2.22}{2.1}$	$\frac{4.07}{2.1}$	$\frac{2.1}{2.1}$
1	2	1

$C_1H_2Cl_1$

$n = \frac{98.96}{49.5} = 2$

$M.F = n \times E.F$

$= 2 \times C_1H_2Cl_1$

$= C_2H_4Cl_2$

Concentration

→ NCERT → Mole Concept → delete kr diya hai

→ liquid sol^n → shift kr diya hai Concentration

Solution = Solute + solvent

Solute ↓ smallamount

solvent ↓ large scale (amount) or solution jiske Jada dikhta hai

Ex → Common salt dissolve in water

Solute → Salt   Solvent ⇒ Water

Ex → 10 gram salt + 10 gram water

Solute = salt

Solvent = water

Q → Cold drink, Solvent = ?

a) water ✓

b) CO_2

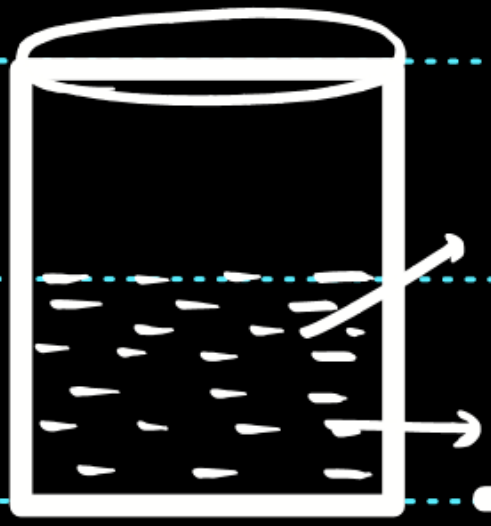
c) Salt

d) sucrose

Mass percentage

1 → Solute → w_1, n_1, v_1, x_1

2 → Solvent → w_2, n_2, v_2, x_2



Solute $= w_1\,g$

Solvent $= w_2\,g$

Solution $= (w_1 + w_2)\,g$

Mass percentage of solute (w/w %)

total amount of solute dissolve in 100 or 10^2 gram of solution

Mass percentage of Solvent → total amount of solvent dissolve in 100 or 10^2 gram of solution

Mass % of <u>solute</u> = $\frac{w_1}{w_1 + w_2} \times 100$

Mass % of <u>solvent</u> = $\frac{w_2}{w_1 + w_2} \times 100$

$\phi \rightarrow$

CSD

Mass % of solute = $\frac{w_1}{w_1+w_2} \times 100$

→ percentage = fraction × 100

→ Mass fraction of solute = $\frac{w_1}{w_1+w_2}$

Mass % of solvent = $\frac{w_2}{w_1+w_2} \times 100$

→ Mass fraction of solvent = $\frac{w_2}{w_1+w_2}$

→ Mass % of solute + Mass % of solvent = 100

→ $\frac{\text{Mass \% of Solute}}{\text{Mass \% of Solvent}} = \frac{w_1}{w_2}$

Note = density ka kam hota hai, Mass ko volume me change krna, vice-versa

$$M = V \times d$$

→ $x\%$ (w/w) solution or $x\%$ by Mass = x gram of solute dissolve in 100 gram solution

(solute over x; solution over w)

Mass of solute $= x\,g$

Mass of solution $= 100\,g$

Mass of solvent $= (100 - x)$ gram

$$V_{sol^n} = \frac{M_{sol^n}}{d_{sol^n}} = \frac{100\,g}{d\,\frac{g}{ml}} = \frac{100}{d}\,ml$$

$$d_{sol^n} = \frac{M_{sol^n}}{V_{sol^n}}$$

→ Note $x\%$ by mass sol^n-1 + $y\%$ by mass sol^n-2 =

Mass % of solute in resultant sol^n

$$= \frac{x+y}{2} =$$

Q. Calculate the mass percentage of benzene (C_6H_6) and carbon tetrachloride (CCl_4) if 22 g of benzene is dissolved in 122 g of carbon tetrachloride (NCERT)

Solute — Solvent

220
144
760
720
2

$$\text{Mass \% of Benzene} = \frac{W_B}{W_B + W_C} \times 100 = \frac{22}{22+122} \times 100 = \frac{2200}{144} = 15.2\%$$

$$\text{Mass \% of } CCl_4 = \frac{W_C}{W_B + W_C} \times 100 = 84.8\% \text{ approx}$$

$$\begin{array}{r} 100 \\ -\ 15.2 \\ \hline 84.8\% \end{array}$$

ARJUNA

Q. 20 gram of NaOH dissolved in 100 ml of water solution at 300K temperature. If the density of solution is 1.2 gram/ml than calculate mass percentage of NaOH.

A 33%

B 3.3%

C 16.77%

D 4%

V_{soln}, d_{soln}

$$M_{soln} = V_{soln} \times d_{soln}$$

$$= 100\,ml \times 1.2\,\frac{g}{ml}$$

$$M_{soln} = 120g$$

$$M_{soln} = w_1 + w_2 = W_{NaOH} + W_{H_2O}$$

$$\text{Mass \% of NaOH} = \frac{W_{NaOH}}{W_{NaOH} + W_{H_2O}} \times 100$$

$$= \frac{20}{120} \times 100 = \frac{200}{12} = \frac{50}{3}$$

$$= 16.77\%$$

Ques - 20 gram NaOH (W_1) dissolve in 100 gram water (W_2, solvent). Calculate ratio of mass % of NaOH and water in sol^n.

(A) $\frac{1}{5}$ ✓

(B) $2/5$

(C) $1/2$

(D) NONE

$$\frac{\text{Mass \% of NaOH (Solute)}}{\text{Mass \% of water (solvent)}} = \frac{W_1}{W_2} = \frac{20}{100} = \frac{1}{5}$$

Ex → 30 % by Mass sol^n of NaOH have density $1.5 \frac{g}{ml}$

30 → Solute, % → solution

Q-1 Mass of NaOH = 30g

Q-2 Mass of solution = 100g

Q-3 Mass of solvent = 100-30 = 70g

Q-4 Volume of Solution = $V_{sol^n} = \frac{M_{sol^n}}{d_{sol^n}}$ $\frac{100\,g}{1.5\,g/ml} = \frac{100}{1.5}\,ml = \frac{1000}{15}\,ml$

Q. 30% by Mass NaOH Solution-1 mix with 10% by mass solution of NaOH, Calculate mass % of NaOH in resultant solution

(30% → 100g; 10% → 100g)

a) 25% (w/w)

b) 15% (w/w)

c) 13% (w/w)

d) 20% (w/w) ✓

Method-1

$$\text{Mass \% of NaOH} = \frac{W_{NaOH}}{W_{soln}} \times 100$$

$$= \frac{30+10}{100+100} \times 100$$

$$= \frac{40}{200} \times 100 = 20\%$$

Method-2

$$\frac{30+10}{2} = 20\%$$

Q → Calculate mass % of solute in resultant solution, which is form by mixing 20 % by mass of NaOH with 40 % by Mass NaOH solution

20 % → 100g   40 % → 100g

a) 30 % ✓

b) 45 %

c) 33 %

d) 28 %

$$\frac{20+40}{2} = 30\%$$

$$\text{Mass \% of NaOH} = \frac{20+40}{100+100} \times 100$$

$$= \frac{60}{200} \times 100 = 30\%$$

THANK YOU !!

MANTHAN NEET 2025

CHEMISTRY

Mole concept

Lecture-11



Sarvesh Sir

Topic

Concentration

Qsd-01 mass percentage of solute and solvent ratio in solution of NaOH is 2:3 , find out of ratio of mass of solute and solvent in solution

A 2:3 ✓

B 5:3

C 1:4

D 2:7

→ $$\frac{\text{Mass \% of solute}}{\text{Mass \% of solvent}} = \frac{w_1}{w_2}$$

Qsd-02 20 gram of NaOH (solute) dissolved in 100 gram of solution (solution), calculate mass percentage of solute NaOH

A 23

B 53

C 14

D NONE

$$\text{Mass \% of solute} = \frac{W_{solute}}{W_{soln}} \times 100$$

$$= \frac{20}{100} \times 100$$

$$= 20\%$$

$\frac{?}{2}$

ARJUNA

Part per million (PPM)

total amount of solute dissolve in 10,00000 gram = 10^6 gram = 1 million gram of solution

$$PPM = \frac{\text{Mass of solute}}{\text{Mass of sol}^n} \times 10^6 = \frac{w_1}{w_1 + w_2} \times 10^6$$

Part per billion (P.P.B)

total amount of solute dissolve in 1 billion = 10^9 gram solution

$$PPB = \frac{\text{Mass of solute}}{\text{Mass of sol}^n} \times 10^9 = \frac{w_1}{w_1 + w_2} \times 10^9$$

CSD

→ Mass % of solute = $\frac{w_1}{w_1+w_2} \times 10^2$

→ PPM = $\frac{w_1}{w_1+w_2} \times 10^6 \rightarrow 10^2 \times 10^4$

→ PPB = $\frac{w_1}{w_1+w_2} \times 10^9 \rightarrow 10^6 \times 10^3$
$\rightarrow 10^2 \times 10^7$

→ PPB = P.P.M $\times 10^3$

PPB = Mass % of solute $\times 10^7$

PPM = Mass % of solute $\times 10^4$

Note → Mass % of solute = PPM = PPB = x

Mass of solute = same

Mass of solvent & Mass of sol^n = different

Q. Calculate the parts per million of SO_2 gas in 250ml water (density $1\ g\ cm^{-3}$) containing 5×10^{-4} g of SO_2 gas.

A. 1

B. 2

C. 10

D. 20

PPM

(W)

$250\ ml \times 1 \frac{g}{ml} = 250\ gram$

$M = V \times d$

$1\ cm^3 = 1\ ml$

$$PPM = \frac{W_1}{W_1 + W_2} \times 10^6$$

$$= \frac{5 \times 10^{-4}}{5 \times 10^{-4} + 250} \times 10^6 = \frac{5 \times 10^2}{250} = 2\ ppm$$

$$\begin{array}{r} 0.0005 \\ 250.0000 \\ \hline 250.0005 \end{array}$$

ARJUNA

Ques - PPM of Mg-ion in pure water is 15. Calculate Mass % of mg-ion in pure water

(A) 15×10^{4}

✓(B) 15×10^{-4}

×(C) 1.5×10^{-4}

(D) 1.5×10^{3}

$$PPM = \text{Mass \% of solute} \times 10^{4}$$

$$15 = \text{Mass \% of solute} \times 10^{4}$$

$$\text{Mass \% of solute} = \underline{15 \times 10^{-4}}$$

Q Solution-A → Mass % = 10

Solution-B → PPM = 10

Solution-C → PPB = 10

Select Correct option

a) Mass of solute is same in solⁿ- A, B & C

b) Mass of Solvent is same in solⁿ- A, B & C

c) Mass of Solution is same in solⁿ- A, B & C

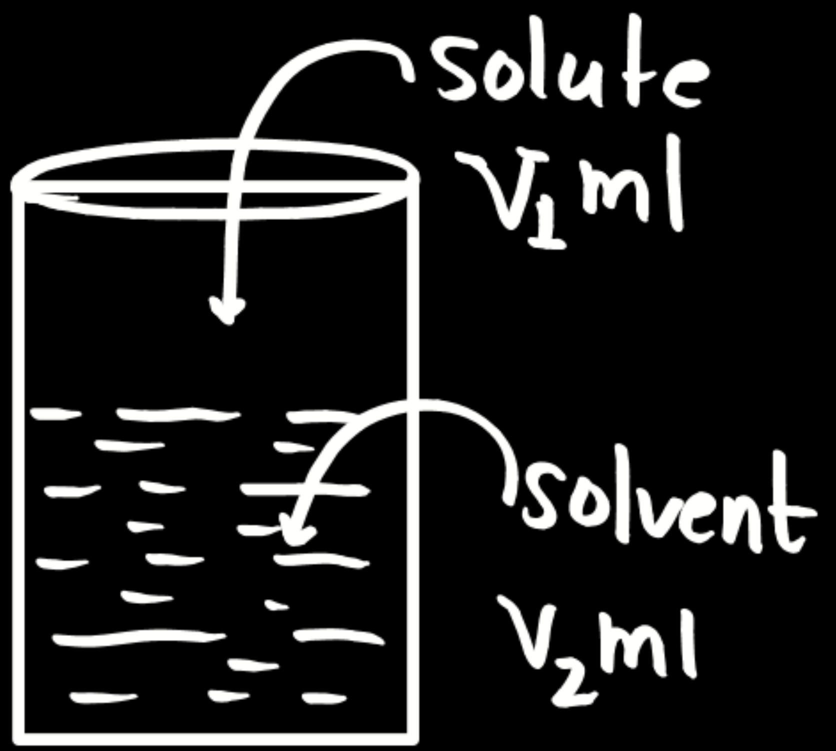
d) Mass of solute is different in solⁿ A, B & C

Volume percentage

total vol. of solute dissolve in 100ml of solution

$$\text{Vol. \% of solute} = \frac{V_1}{V_1+V_2} \times 100$$

$$\text{Vol \% of Solvent} = \frac{V_2}{V_1+V_2} \times 100$$



Volume of solⁿ = (V_1+V_2) ml

Q 100 ml ethyl alcohol mixed with 500 ml water in a container calculate volume percentage of ethyl alcohol.

A 20%

B 15%

C 15.75%

D 16.67% ✓

$$\text{Vol. \% of } C_2H_5OH = \frac{V_e}{V_e + V_w} \times 100$$

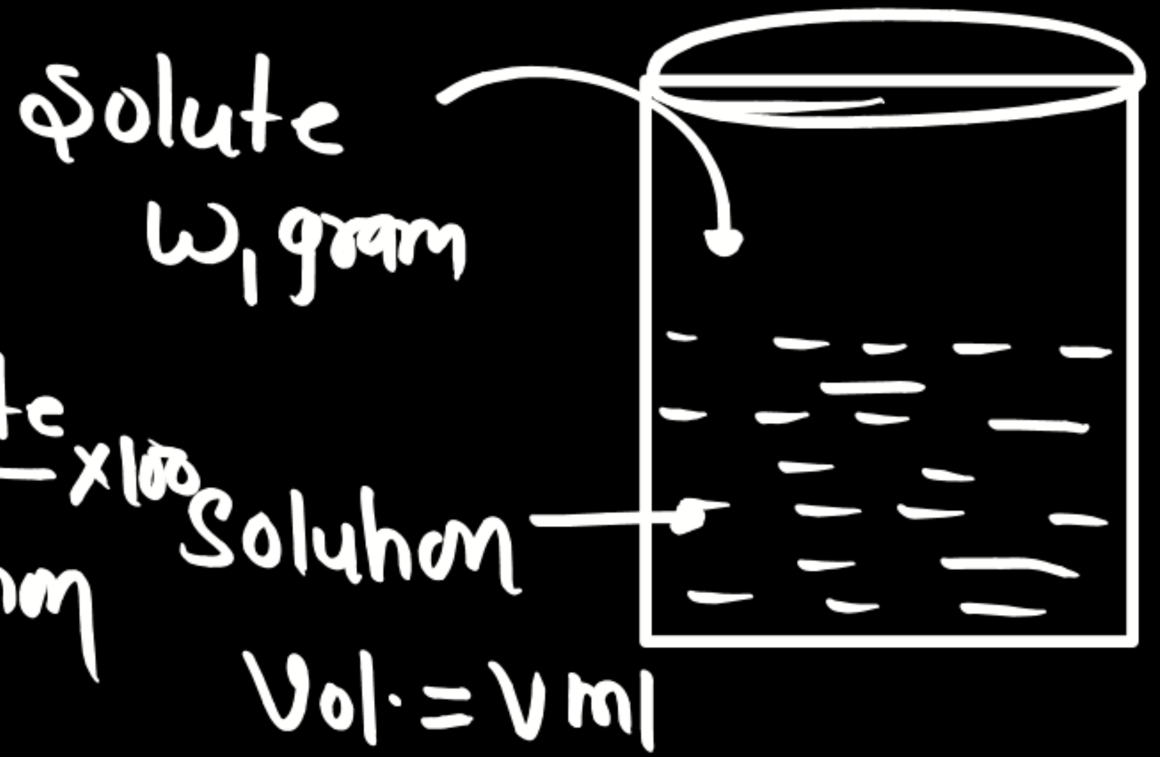
$$= \frac{100}{100+500} \times 100$$

$$= \frac{100}{600} \times 100 = \frac{50}{3} = 16.67$$

Mass by volume percentage

total amount of solute dissolve in 100ml of solⁿ

$$(w/v)\ \%\ \text{of solute} = \frac{\text{Mass of solute}}{\text{Vol. of solution}} \times 100$$



C_{SD}

$x\%$ (w/w)	$x\%$ (w/v)	$x\%$ (v/v)
Solute Solution		
→ x gram solute	→ x gram solute	→ x ml of solute
→ 100 gram solution	→ 100 ml solution	→ 100 ml of solution
→ Mass of solvent $= (100 - x)$ g	→ Mass of $sol^n = 100 \times d_{sol^n}$	→ Vol. of solvent $= (100 - x)$ ml
→ Volume of $sol^n = \frac{100}{d_{sol^n}}$ ml	$= 100\,ml \times d_{sol^n} \left(\frac{g}{ml}\right)$	→ Mass of $sol^n = V_{sol^n} \times d_{sol^n}$
$V = \frac{M}{d}$ $\left(\frac{g}{ml}\right)$	$= 100d$ gram	$= 100\,ml \times d \left(\frac{g}{ml}\right)$
	Mass of solvent $= 100d - x$	$= 100d$ gram

40 gram sugar dissolved in 200 ml water Calculate concentration of sugar solution in terms of mass by volume percentage [(W/V)%]

Vol. of soln ≈ vol. of solv

A 20% ✓

B 25%

C 30%

D 22%

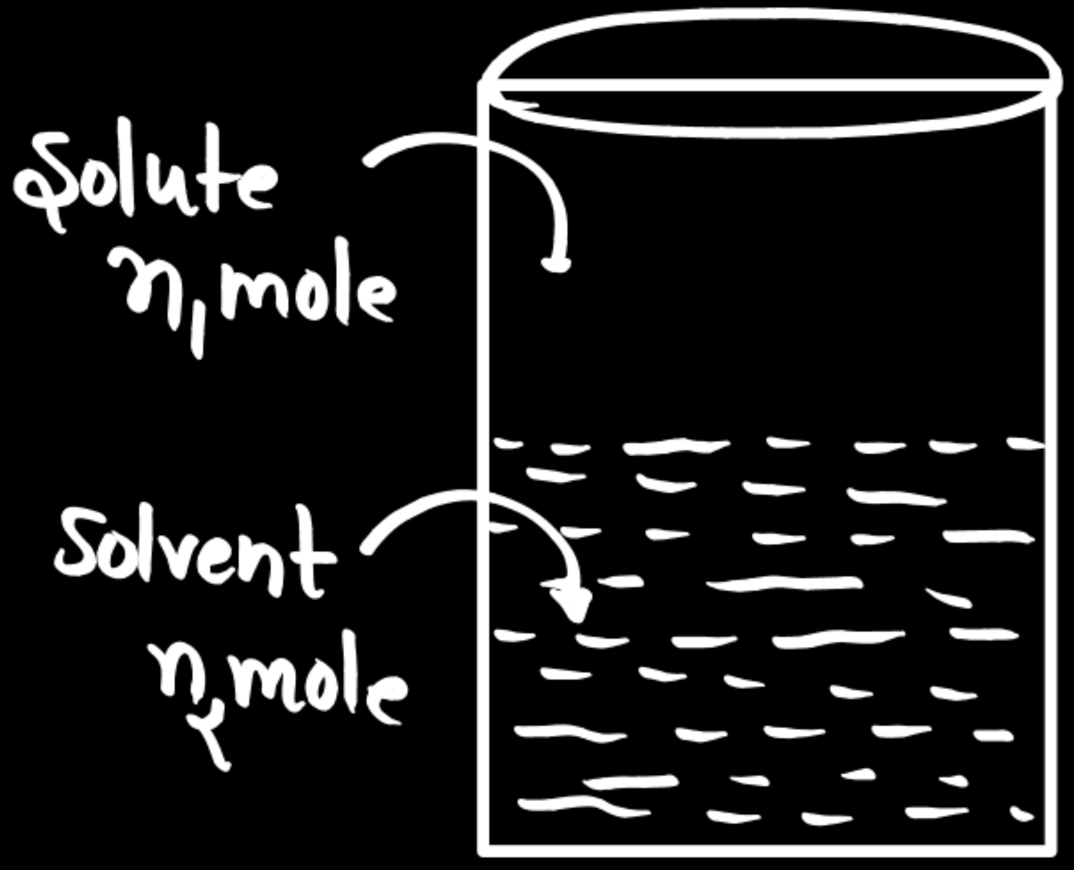
$$\text{Mass by vol \% or } (w/v)\% = \frac{\text{Mass of sugar}}{\text{Vol. of soln}} \times 100$$

$$= \frac{40}{200} \times 100 = 20$$

MOLE FRACTION

Mole fraction of solute (X_1) → chai

total mole of solute dissolve in 1 mole of solution → $X_1 = \frac{n_1}{n_1+n_2}$



total mole of sol^n = (n_1+n_2) mole

Mole fraction of solvent (X_2)

total mole of solvent dissolve in 1 mole of solution → $X_2 = \frac{n_2}{n_1+n_2}$

CSD

- $X_1 = \frac{n_1}{n_1+n_2}$
- $X_2 = \frac{n_2}{n_1+n_2}$
- $X_1 + X_2 = 1$
- $\frac{X_1}{X_2} = \frac{n_1}{n_2}$ ***

- percentage = fraction × 100
- Mole % of solute = $\frac{n_1}{n_1+n_2} \times 100$
- Mole % of solvent = $\frac{n_2}{n_1+n_2} \times 100$

Note x % (w/w) solⁿ = given, X_1 or X_2 = ?

x gram solute, 100 gram solution, (100 − x) gram of solvent

Q → 20% by mass NaOH solution present in a Container.

Calculate mole fraction of NaOH in solution.

a) 0.4

b) 0.25

c) 0.72

d) NONE ✓

20% (w/w)

Mass of NaOH = 20g, $n_{NaOH} = \frac{20}{40} = 0.5$

Mass of soln = 100g.

Mass of H_2O (solvent) = 100 − 20 = 80g, $n_{H_2O} = \frac{80}{18} = \frac{40}{9} = 4.5$

$X_{NaOH} = \frac{0.5}{0.5+4.5} = \frac{0.5}{5.0} = \frac{0.5}{5} = \frac{1}{10} = 0.1$

Q. The mole fraction of glucose ($C_6H_{12}O_6$) in an aqueous binary solution is 0.1. The mass percentage of water in it, to the nearest integer, is(Jee-Main 2019)

Sol^n → $X_g = 0.1$

$X_1 + X_2 = 1$

$X_{H_2O} = 0.9$

$0.1 + X_2 = 1$

$X_2 = 1 - 0.1 = 0.9$

$$\frac{X_g}{X_{H_2O}} = \frac{n_g}{n_{H_2O}} = \frac{0.1}{0.9} = \frac{1}{9}$$

1620
1368
2520
2394
126

$n_g = 1$ mole, $W_g = 1 \times 180 = 180g$

$n_{H_2O} = 9$ mole, $W_{H_2O} = 9 \times 18 = 162g$

$$\text{Mass \% water} = \frac{162}{180+162} \times 100 = \frac{16200}{342} = 47.3\%$$

Ques -

(A)

(B)

(C)

(D)

THANK YOU !!

MANTHAN NEET 2025

SANKALP NEET VEDANTU

Chapter → Mole Concept & Equivalent wt

↓

Tatva-module

Ex-1 → 43 to 85 Questn

PYQ → Ex-2 ⇒ 1 to 9 Questn

CHEMISTRY

Mole concept

Lecture-12



Sarvesh Sir

Topic

Concentration

Test Ka syllabus

- → Matter & classification
- → mole
- → Atomic wt & Avg. A wt.
- → E.F. & M.F.

Qsd-01 2 mole each solute and solvent mix with each other in a container, calculate the mole percentage of solute $- \frac{n_1}{n_1+n_2}$

A. 0.5

B. 5

C. 50 ✓

D. none

$$\text{Mole \%} = \text{Mole fraction} \times 100$$

$$= \frac{2}{2+2} \times 100 = \frac{2}{4} \times 100 = 50\%$$

Qsd-02 mole fraction of NaOH in aqueous solution of NaOH is 0.2 , calculate mass percentage of NaOH in solution

A 2.3

B 0.53

C 0.14

D NONE

$\frac{?}{2}$

$X_{NaOH} = 0.2$

$X_{H_2O} = 0.8$

$\frac{X_{NaOH}}{X_{H_2O}} = \frac{n_{NaOH}}{n_{H_2O}} = \frac{0.2}{0.8} = \frac{1}{4}$

$n_{NaOH} = 1,\ W_{NaOH} = 1 \times 40 = 40g$

$n_{H_2O} = 4,\ W_{H_2O} = 4 \times 18 = 72g$

$$\text{Mass \% of NaOH} = \frac{W_{NaOH}}{W_{NaOH} + W_{H_2O}} \times 100$$

$$= \frac{40}{40+72} \times 100$$

$$= \frac{40}{112} \times 100 = \frac{1000}{28} = \frac{250}{7} = 35.71\%$$

ARJUNA

molality

→ total mole of solute dissolve in 1Kg = 1000 gram of solvent

$$m = \frac{n_{solute}}{\text{Mass of Solvent (kg)}} = \frac{n_{solute}}{\text{Mass of sol}^{v}\text{ (gram)}} \times 10^{3}$$

→ Represent → m

→ unit = mole/kg

CSD

$$m = \frac{n_{solute}}{\text{Mass of sol}^n\,(\text{Kg})} = \frac{n_{solute}}{\text{Mass of sol}^n\,(\text{gram})} \times 10^3$$

→ Represent → m

→ unit = $\frac{\text{mole}}{\text{kg}}$

$$m = \frac{n_{solute} \times 10^3}{\text{Mass of sol}^n - \text{Mass of solute}}$$

(Mass % = given)

$$m = \frac{n_{solute} \times 10^3}{V_{sol^n} \times d_{sol^n} - \text{Mass of solute}}$$

((w/v) %, d_{sol^n} = given)

V_{sol^n} → ml, d_{sol^n} → $\frac{g}{ml}$

Relation b/w molality and mole fraction

$$\frac{X_1}{X_2} = \frac{n_1}{n_2} = \frac{n_{solute}}{\frac{W_{solv}}{M.wt}} = \frac{n_{solute} \times 1000}{Mass\ of\ solv} \times \frac{M.wt\ of\ solvent}{1000}$$

$$\boxed{\frac{X_1}{X_2} = \frac{molality \times M.wt\ of\ solvent}{1000}}$$

$A_xB_y \Rightarrow$ molality of $A_xB_y = m$

$$1\,A_xB_y \rightarrow x\,A^{+y} + y\,B^{-x}$$

	A_xB_y	A^{+y}	B^{-x}	
	m	0	0	t=0
		x×m	y×m	

Molality of A^{+y} ion = x×m

Molality of B^{-x} ion = y×m

Ex → 0.4m $Al_2(SO_4)_3$

$m_{Al^{+3}} = 2 \times 0.4m$

$m_{SO_4^{-2}} = 3 \times 0.4m$

Q. A molal solution is one that contains one mole of solute in

$m = 1$

NEET-2022

(A) 1000 g of solvent ✓

(B) 1.0 L of solvent

(C) 1.0 L of solution

(D) 22.4 L solution

$$m = \frac{n_{solute}}{\text{Mass of sol}^{v}\ (\text{gram})} \times 10^3$$

$$1 = \frac{1}{\text{Mass of sol}^{v}} \times 1000$$

Mass of sol^{v} = 1000 gram

Q. What would be the molality of 20% (mass/mass) aqueous solution of KI? (Molar mass of KI = 166 g mol[-1])

NEET

(A) 1.48

(B) 1.51

(C) 1.35

(D) 1.08

$$m = \frac{n_{solute} \times 10^3}{M_{soln} - M_{solute}}$$

$$= \frac{(20/166) \times 10^3}{100 - 20} = \frac{20 \times 1000}{166 \times 80} = \frac{250}{166} = 1.5$$

250
166
940

830

Q → density of 20% (w/v) aqueous solⁿ of NaOH is 1.2 g/ml. Calculate molality of solution

a) 1.25 m

b) 1.04 m

c) 2.3 m

d) NONE

$$m = \frac{n_{solute} \times 10^3}{V_{soln} \times d_{soln} - W_{solute}}$$

$$= \frac{(20/40) \times 1000}{100\,ml \times 1.2\,\frac{g}{ml} - 20} = \frac{20 \times 1000}{40 \times 100} = \frac{20}{4} = 5\,m$$

Mole fraction of acetic acid in an aqueous sample is 0.1. The molality of the solution is

H_2O

P.Y.Q.

A 7.16 mol kg^{-1}

B 1.67 mol kg^{-1}

C 6.17 mol kg^{-1}

D 5.25 mol kg^{-1}

$$\begin{array}{r} 500 \\ 486 \\ \hline 140 \end{array}$$

$$\frac{X_1}{X_2} = \frac{m \times M.wt\ of\ sol^v}{1000}$$

$$\frac{0.1}{0.9} = \frac{m \times 18}{1000}$$

$$m = \frac{1000}{9 \times 18} = \frac{500}{81} = 6.1$$

Q. Molality of aqueous solution of $Ca_3(PO_4)_2$ is 0.6m. Calculate the molality of phosphate ions(PO_4^{-3})

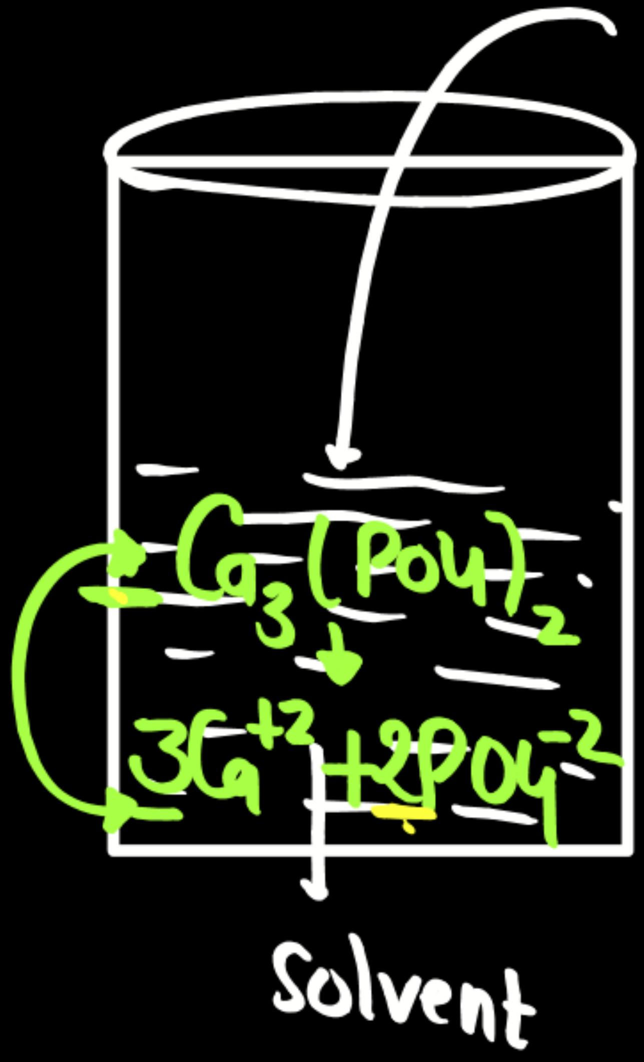
$\rightarrow m_{PO_4^{-3}} = 2 \times 0.6 = 1.2m$

A 1.2m ✓

B 0.6m

C 2.4m

D 1.8m



$$m_{PO_4^{-3}} = \frac{n_{PO_4^{-3}}}{\text{Mass of sol}^n} \times 10^3$$

$\rightarrow m_{PO_4^{-3}} \propto n_{PO_4^{-3}}$

$m_{Ca^{+2}} = 3 \times m_{Ca_3(PO_4)_2}$

$m_{PO_4^{-3}} = 2 \times m_{Ca_3(PO_4)_2}$

Molarity of solution

total mole of solute dissolve in 1 litre = $1\,dm^3$ = $1000\,cm^3$ = 1000 ml of solution

$$M = \frac{n_{solute}}{\text{Vol. of sol}^n\text{ (litre)}} = \frac{n_{solute} \times 1000}{\text{Vol. of sol}^n\text{ (ml)}}$$

Represent → M

Unit → $\frac{\text{mole}}{\text{litre}}$

CSD

$$M = \frac{n_{solute}}{\text{Vol. of sol}^n\ (\text{Litre})}$$

unit → $\frac{\text{mole}}{\text{Litre}}$ or M

$$M = \frac{n_{solute} \times 1000}{\text{Vol. of sol}^n\ (\text{ml})}$$

****

$$M = \frac{n_{solute} \times d_{sol^n}\ (\text{g/l}) \times 10^3}{\text{Mass of sol}^n\ (\text{g})}$$

(Mass %, d_{sol^n} = given)

Molarity of ions

Molarity of A_xB_y = M

Molarity of A^{+y} ion = $x \times M$

Molarity of B^{-x} ion = $y \times M$

$$A_xB_y \rightarrow xA^{+y} + yB^{-x}$$

$$M = \frac{n_{solute}}{\text{Vol. of sol}^n}$$ → Constant

→ $M \propto n_{solute}$

Q → density of 63% by mass solution of HNO_3 is $1.25 \frac{g}{ml}$

Calculate molarity of HNO_3 sol^n.

$1+14+48=63$

a) 2.75 M

b) 7.0 M

c) 0.81 M

~~d)~~ NONE

$$M = \frac{n_{solute} \times d_{sol^n}\left(\frac{g}{ml}\right) \times 10^3}{M_{sol^n}(g)}$$

$$= \frac{(63/63) \times 1.25 \times 1000}{100}$$

$$= 12.5\,M$$

Q Molarity of $Al_2(SO_4)_3$ in solution is 0.2M

Calculate molarity of Al^{+3} in solution

a) 0.2M

b) 0.6M

c) 0.4M

d) NONE

$$M_{Al^{+3}} = 2 \times M_{Al_2(SO_4)_3}$$

$$= 2 \times 0.2 = 0.4M$$

Effect of temperature in Concentration term

temp → Mass, mole → Koi effect nahi Krta hai

temp → Effect Krta hai → Volume pr

↑ temp ∝ Volume ↑

(w/w)%, Mole fraction, molality, PPM, PPB, → X → No effect temp.

(w/v)%, (v/v)%, density $\left(\frac{M}{V}\right)$, Molarity $\left(\frac{\text{mole}}{\text{Vol}}\right)$, Normality $\left(\frac{\text{gram Eq.}}{\text{Vol.}}\right)$ → Effect by temp.

Q. .How mamy concentration term is not effected by temperature change , mass % , (v/v) % , mole fraction , mole % , (w/v) % , PPM ,PPB

A 2

B 5

C 3

D 4

Q. A solution of sodium sulphate contains 92 g of Na^+ ions per kilogram of water. The molality of Na^+ ions in that solution in mol kg^{-1} is (JEE-PYQ)

Na2SO4

A 16 H.W.

23

B 4 ✓

C 132

D 8

$$m_{Na^+} = \frac{n_{Na^+}}{\text{Mass of soln (kg)}} = \frac{(92/23)}{1} = \frac{92}{23} = 4$$

Ques -

(A)

(B)

(C)

(D)

THANK YOU !!

MANTHAN NEET 2025

Qsd →

CHEMISTRY

Mole concept

Lecture-13



Sarvesh Sir

Topic

Concentration

Qsd-01 mole fraction ratio of solute and solvent is 1:2 in aqueous solution of glucose and molality of solution is

find out

A 0.5

B 0.25

C 5.0

D none //

$$\frac{X_1}{X_2} = \frac{m \times M.wt\ of\ solvent}{1000}$$

$$\frac{1}{2} = \frac{m \times 18}{1000}, \quad m = \frac{250}{9} = 27.78\ m$$

Qsd-02 20% mass by volume percentage of NaOH solution present in a container calculate molarity of solution

w/v

20 gram 100 ml

A 2.3

B 0.53

C 0.14

D NONE

$$M = \frac{n_{solute} \times 10^3}{\text{Vol. of sol}^n\,(ml)} = \frac{(20/40)}{100} \times 1000 = \frac{20 \times 1000}{100 \times 40}$$

$= \underline{5M}$

$\frac{?}{2}$

ARJUNA

Molarity of Mixture of salt

$$M = \frac{n_{solute}}{\text{Vol. of sol}^n (L)}$$

$$n_{solute} = M \times V(L)$$

→ No. of mole of solute = Molarity × Vol. of solⁿ (L)

Q – How many mole of NaOH dissolve in 100ml, 0.2M NaOH aqueous solution.

a) 20 mole

b) 0.02 mole ✓

c) 0.2 mole

d) None

$$n_{NaOH} = M \times V(L)$$

$$0.2 \times 100 \times 10^{-3} (L)$$

$$= 0.2 \times 10^{-1}$$

$$= 0.02 \text{ mole}$$

C_{SD}

$$M = \frac{n_{solute}}{\text{Vol. of sol}^n\ (L)} = \frac{n_{solute} \times 10^3}{\text{Vol. of sol}^n\ (ml)}$$

**** **No. of mole of solute = $M \times V\ (L)$**

Dilution = only addition of solvent (water)

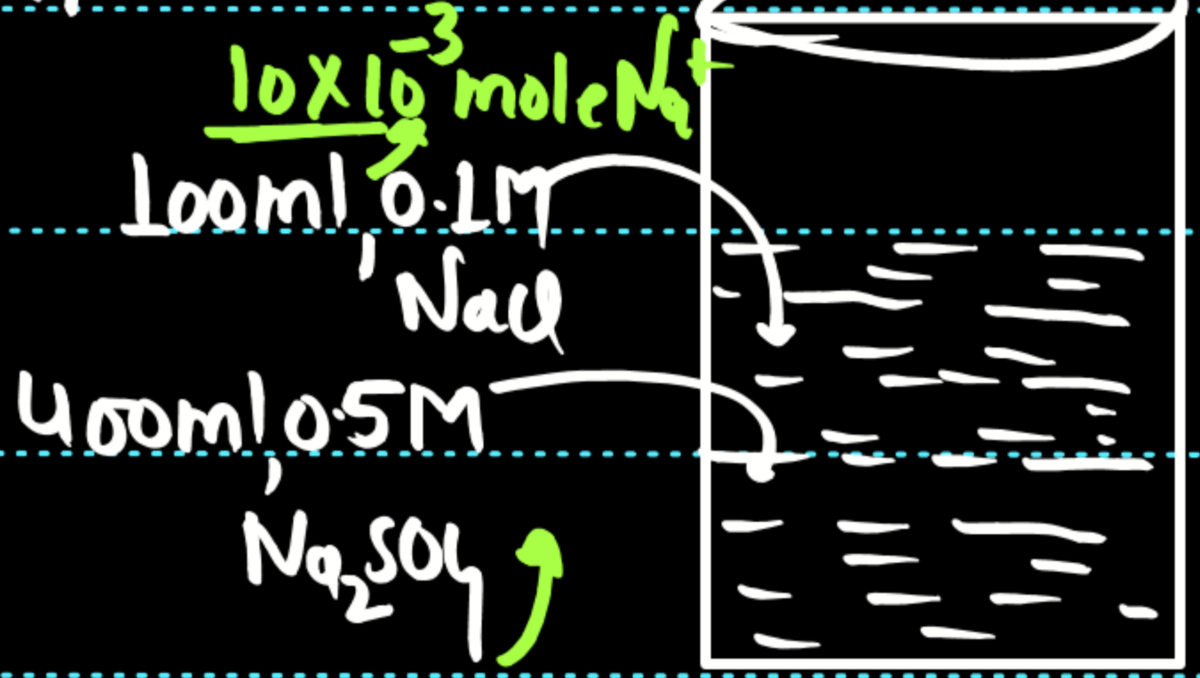
No. of mole of solute same before dilution and After dilution

Q- 100 ml 0.1 M NaCl mix with 400 ml, 0.5 M Na_2SO_4 solution

$0.1 \times 100 \times 10^{-3}$ mole Na^+ $\qquad$ $0.5 \times 400 \times 10^{-3}$ mole Na_2SO_4

Calculate molarity of Na^+-ion in resultant solution

Sol^n Volume of sol^n = 400 + 100 = 500 ml



$$M_{Na^+} = \frac{n_{Na^+} \times 10^3}{\text{Vol. of sol}^n\ (\text{ml})}$$

$$= \frac{(400 \times 10^{-3} + 10 \times 10^{-3}) \times 10^3}{500}$$

$$\frac{410}{500} = 0.82\ M$$

$0.5 \times 400 \times 10^{-3} \times 2$ mole Na^+

400×10^{-3}

Q-2 → molarity of Cl^--ion in resultant solution

$$M_{Cl^-} = \frac{n_{Cl^-} \times 1000}{\text{Vol. of sol}^n \text{(ml)}}$$

$$= \frac{10 \times 10^{-3} \times 10^{3}}{500}$$

$$= \frac{10}{500} = \frac{\cancel{10}^{2}}{\cancel{5}} \times 10^{-2} = 2 \times 10^{-2} = \underline{0.02M}$$

Molarity of Mixture of acid or base

Base		Acid		Salt (BA)
M_1, V_1 litre	+	M_2, V_2 L	→	$(V_1 + V_2)$ L → total vol. of resultant solution
M_1V_1 mole of Base (BOH)		M_2V_2 mole of Acid (HA)		

$$AH + BOH \longrightarrow BA + H_2O$$

Q 1L, 0.2M NaOH neutralise by 2L, 0.1M HCl solution
→ mole = M × V

Calculate molarity of NaCl in resultant solution.

a) 0.12M

b) 0.25M

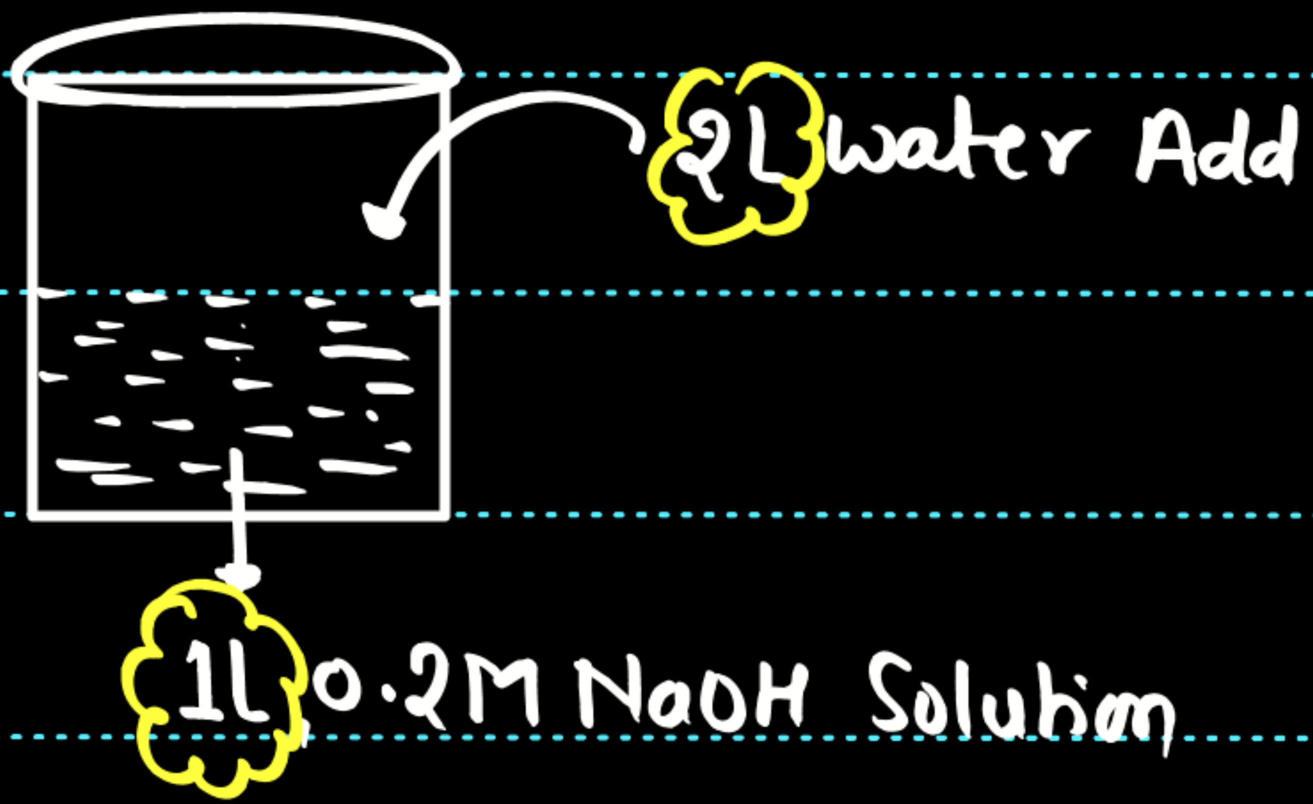
c) 0.35M

d) NONE

$$M_{NaCl} = \frac{n_{NaCl}}{\text{Vol. of sol}^n (L)} = \frac{0.2}{3 \text{ Litre}} = 0.067\,M$$

$1\,NaOH$	+	$1\,HCl$	$\longrightarrow$	$NaCl$	+	H_2O
0.2 mole		0.2 mole		0		0
0				0.2 mole		0.2 mole

Dilution → Addition of solvent only (water)



Q → Mole of solute (NaOH) Change → a) yes b) NO ✓

Q → Vol. of sol^n change

✓ a) yes b) NO

Q → 1L, 0·2M NaOH solution diluted 100 times than calculate Con. of NaOH in resultant solⁿ.

a) 0·2M

b) 2×10^{-3} M

c) 2×10^{-2} M

d) NONE

$1 \times 0.2 = 0.2$ mole

$100 \times 1L = 100L$

$$M_{NaOH} = \frac{n_{NaOH}}{\text{Vol. of sol}^n (L)}$$

$$= \frac{0.2}{100L} = 2 \times 10^{-3} M$$

Q. 1L, 0.2M HCl mix with 2L, 0.1M HCl other solution

0.2 mole HCl ... 0.2 mole HCl

and further diluted with water, finally 10L resultant

solⁿ form, Calculate Con of HCl in final solⁿ

a) 0.15M

b) 1.5M

c) 0.23M

d) NONE

$$M_{HCl} = \frac{n_{HCl}}{\text{Vol of sol}^n\,(L)} = \frac{(0.2+0.2)\,\text{mole}}{10L}$$

$$= \frac{0.4}{10} = 0.04M$$

Q. Molarity of aqueous solution of $Zn_3(PO_4)_2$ is 0.6M. Calculate the molarity of Zn ions(Zn)

$3Zn^{+2}$

A 1.2M

B 0.6M

C 2.4M

D 1.8M

$M_{Zn^{+2}} = 3 \times 0.6$

$= 1.8M$

Q. 100 ml, 0.2 m NaCl solution mixed with 400 ml, 0.5 m $CaSO_4$ solution. Calculate concentration (molarity) of SO_4^{2-} ion

0.4 M

0.5M

0.2 M

0.6 M

Example 1.1 Calculate the mole fraction of ethylene glycol ($C_2H_6O_2$) in a solution containing 20% of $C_2H_6O_2$ by mass.

20% (w/w) $C_2H_6O_2$ → CH_2OH–CH_2OH

→ 20 gram → $C_2H_6O_2$

100 gram → $C_2H_6O_2 + H_2O$

→ Mass of H_2O = 100 − 20 = 80 g

24 + 6 + 32

= 62

$$X_e = \frac{n_e}{n_e + n_w}$$

$$X_e = \frac{(20/62)}{\frac{20}{62} + \frac{80}{18}}$$

=

Example 1.2 Calculate the molarity of a solution containing 5 g of NaOH in 450 mL solution.

H.W.

Intext Questions

1.1 Calculate the mass percentage of benzene (C_6H_6) and carbon tetrachloride (CCl_4) if 22 g of benzene is dissolved in 122 g of carbon tetrachloride.

1.2 Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride.

H.W.

1.3 Calculate the molarity of each of the following solutions: (a) 30 g of $Co(NO_3)_2 . 6H_2O$ in 4.3 L of solution (b) 30 mL of 0.5 M H_2SO_4 diluted to 500 mL.

1.4 Calculate the mass of urea (NH_2CONH_2) required in making 2.5 kg of 0.25 molal aqueous solution.

H.W.

1.4 Calculate the mass of urea (NH_2CONH_2) required in making 2.5 kg of 0.25 molal aqueous solution.

1.5 Calculate (a) molality (b) molarity and (c) mole fraction of KI if the density of 20% (mass/mass) aqueous KI is 1.202 g mL^{-1}.

H.W.

THANK YOU !!

MANTHAN NEET 2025

Qsd

CHEMISTRY

Mole concept

Lecture-14



Sarvesh Sir

Topic

Concentration stoichiometry

Qsd-01 4 mole Na3PO4 dissolve in 1 litre water , selection the correct option

$M_{Na^+} = 3 \times M_{Na_3PO_4}$

A MOLARITY OF NaPO4 =2M

B MOLARITY OF NA ION =3X MOALRITY OF Na3PO4

C MOLARITY OF NA ION =2M

D none

$$M_{Na_3PO_4} = \frac{n_{Na_3PO_4}}{\text{Vol. of sol}^n (L)} = \frac{4}{1} = 4M$$

$$M_{Na^+} = 3 \times M_{Na_3PO_4} = 3 \times 4 = 12M$$

Qsd-02 Density of 60 % by mass of acetic acid solution is 1.0 g/ml , calculate the molarity of solution

60g – CH_3COOH

100g → sol^n

A 2.12M

B 0.53M

C 0.14M

D NONE ✓

$$M = \frac{n_{solute} \times d_{sol^n}\left(\frac{g}{ml}\right) \times 10^3}{(Mass)_{sol^n}}$$

$$= \frac{(60/60) \times 1.0 \times 1000}{100}$$

$$= 10M$$

$\frac{?}{2}$

ARJUNA

Normality → detail theory = Redox Reaction
→ Mole Concept = only definition & formula

total No. of gram Equivalent of solute dissolve in 1 litre of Solution

$$\text{Mole} = \frac{\text{wt}}{\text{M.wt}}, \quad \text{No. of gram Equivalent} = \frac{\text{wt}}{\text{Equivalent wt}}$$

$$\text{Normality} = \frac{\text{No. of gram Eq. of solute}}{\text{Vol. of solution (L)}}$$

Q→ 4 gram of NaOH (E.wt = 40) dissolve in 2 litre solution
Calculate Normality of NaOH solution

a) 0.04N b) 0.05N c) 0.1N d) 2.5N

$$N = \frac{\text{No. of gram Eq. of solute}}{\text{Vol. of soln (L)}}$$

$$= \frac{(4/40)}{2} = \frac{4}{40 \times 2} = \frac{5}{100} = 0.05$$

$$= 0.05\,N$$

Stoichiometry

Quantative Analysis of Reactant & product in a chemical reaction is Known as Stoichiometry

Step → $n_1 A + n_2 B \longrightarrow A_{n_1} B_{n_2}$ → Balance

CSD

Stoichiometry

① $\text{Mole} = \frac{wt}{M \cdot wt} = \frac{\text{Number}}{N_A} = \frac{V_{\text{gas at STP}}}{22.4}$

$\text{Mole} = M \times V\,(L)$

Step-1 → Balance rxn likho

$n_1 A + n_2 B \longrightarrow n_3 AB$ (Balance)

Step-2 → Given information → Convert into MOLE

Step-3

$$\frac{(\text{Mole})_A}{(\text{Stoi})_A} = \frac{(\text{Mole})_B}{(\text{Stoi})_B} = \frac{(\text{Mole})_{AB}}{(\text{Stoi})_{AB}} \Rightarrow \frac{n_A}{n_1} = \frac{n_B}{n_2} = \frac{n_{AB}}{n_3}$$

Q. .Molarity of aqueous solution of $Zn_3(PO_4)_2$ is 0.6M. Calculate the molarity of Zn ions(Zn)

- 1.2*M*
- 0.6M
- 2.4*M*
- 1.8M

H.W.

Q42. What is the weight of oxygen required for the complete combustion of 2.8 kg of ethylene? (C_2H_4) [CBSE AIPMT 1989]

(a) 2.8 kg (b) 6.4 kg

(c) 9.6 kg ✓ (d) 96 kg

$$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$$

2.8×10^3 g

$\frac{2.8 \times 10^3}{28} = 10^2$ mole

$\frac{n_{C_2H_4}}{1} = \frac{n_{O_2}}{3} \Rightarrow \frac{10^2}{1} = \frac{n_{O_2}}{3}$

$n_{O_2} = 3 \times 10^2$ mole

$W_{O_2} = 3 \times 10^2 \times 32 = 9600$ g $= 9.6$ kg

Combustion = Rxn with O_2

$C \longrightarrow CO_2$

$H \longrightarrow H_2O(l)$ $T < 100°C$

$H_2O(v)$ $T > 100°C$

$S \longrightarrow SO_2$

$O \longrightarrow$ No prd

$N \longrightarrow NO_2, NO, N_2O$

$$C_6H_6 + O_2 \longrightarrow CO_2 + H_2O$$

$$C_2H_5OH + O_2 \longrightarrow CO_2 + H_2O$$

Q31. Liquid benzene (C_6H_6) burns in oxygen according to the equation, $2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(g)$. How many litres of O_2 at STP are needed to complete the combustion of 39g of liquid benzene? (Mol. Weight of O_2 = 32, C_6H_6 = 78) **[CBSE AIPMT 1996]**

(a) 74 L (b) 11.2 L

(c) 22.4L (d) 84L

$2C_6H_6(l) + 15O_2 \longrightarrow 12CO_2 + 6H_2O$

39g

$\frac{39}{78} = \frac{1}{2}$ mole $= 0.5$ mole

$\frac{n_{C_6H_6}}{2} = \frac{n_{O_2}}{15}$

$\frac{0.5}{2} = \frac{n_{O_2}}{15}$

$n_{O_2} = \frac{0.5 \times 15}{2}$ mole

V_{O_2} at S.T.P = Mole × 22.4

$= \frac{0.5 \times 15}{2} \times 22.4$ (11.2)

$= 7.5 \times 11.2$ L

84.00L

Q25. Assuming fully decomposed, the volume of CO_2 released at STP on heating 9.85 g of $BaCO_3$ (at mass of Ba = 137) will be **[CBSE AIPMT 2000]**

(a) 1.12 L (b) 0.84 L

(c) 2.24 L (d) 4.96 L

137
12
48
197

$BaCO_3 \longrightarrow BaO + CO_2$

9.85 g

$\frac{9.85}{197}$ 0.05 mole

$\frac{n_{BaCO_3}}{1} = \frac{n_{CO_2}}{1}$

$\frac{0.05}{1} = \frac{n_{CO_2}}{1}$

$n_{CO_2} = 0.05$ mole

$V_{O_2} = 0.05 \times 22.4$

1.120 L

= 1.12 L

Q19. The mass of carbon anode consumed (giving only carbon dioxide) in the production of 270 kg of aluminium metal from bauxite by the Hall process is (at. Mass of Al = 27) **[CBSE AIPMT 2005]**

(a) 180 kg (b) 270 kg

(c) 540 kg (d) 90 kg

$$2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$$

$$\frac{270 \times 10^3 \text{ gram}}{27} = 10^4 \text{ mole}$$

$$\frac{n_C}{3} = \frac{n_{Al}}{4}$$

$$n_C = \frac{3}{4} \times 10^4 \text{ mole}$$

$$W_C = \frac{3}{4} \times 10^4 \times 12 = 90 \times 10^3 \text{ gram} = 90 \text{ kg}$$

Q41. A metal oxide has the formula Z_2O_3. It can be reduced by hydrogen to give free metal and water. 0.1596 g of the metal oxide requires 6 mg of hydrogen for complete reduction. They atomic weight of the metal is

[CBSE AIPMT 1989]

(a) 27.9 (b) 159.6
(c) 79.8 (d) 55.8

$$\underline{2A_Z+48}\; Z_2O_3 + 3H_2 \longrightarrow 2Z + 3H_2O$$

$$0.1596\,g \qquad 6\times10^{-3}\,g$$

$$\frac{0.1596}{2A_Z+48}\text{ mole} = \frac{6}{2}\times10^{-3}\text{ mole}$$

$$\frac{n_{Z_2O_3}}{1} = \frac{n_{H_2}}{3}$$

$$\frac{0.1596}{2A_Z+48} = \frac{3\times10^{-3}}{3} = 10^{-3}$$

$$2A_Z+48 = 159.6$$

$$2A_Z = 111.6$$

$$A_Z = \frac{111.6}{2} = 55.8$$

S.T.P.

Q13. What volume of oxygen gas (O_2) measured at 0ºC and 1 atm, is needed to burn completely 1L of propane gas (C_3H_8) measured under the same conditions? [CBSE AIPMT 2008]

(a) 7L (b) 6L

(c) 5L ✓ (d) 10L

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

1L ?

$$\frac{(1/22.4)}{1} = \frac{n_{O_2}}{5}$$

$$n_{O_2} = 5 \times \frac{1}{22.4} \text{ mole}$$

$$V_{O_2} = 5 \times \frac{1}{22.4} \times 22.4$$

$$= 5L$$

Q. 1 g of carbonate (M_2CO_3) on treatment with excess HCl produces ~~0.1186~~ 0.01186 mole of CO_2. The molar mass of M_2CO_3 in g mol^{-1} is (Jee-Main 2017)

A 1186

B 84.3

B 118.6

D 11.86

H.W.

$$M_2CO_3 + 2HCl \longrightarrow 2MCl + H_2O + CO_2$$

Case → 1 successive Reaction

$A \longrightarrow B$

$B \longrightarrow C$

$C \longrightarrow D$

? → Successive Rxn

CSD → ① Rxn - Balance Karo

② Given information → Convert into MOLE

(3) $\frac{\text{Mole}}{\text{Stoi.}}$ Ratio ⇒ ek se jada bar equate Krna hai

Q

1.2g

$C + \frac{1}{2}O_2 \longrightarrow CO$

$CO + \frac{1}{2}O_2 \longrightarrow CO_2$ → ?

what amount of CO_2 form. If 1.2 gm Carbon used in chemical reaction.

~~(a)~~ 0.1 mole

(b) 1 mole

(c) 0.2 mole

(d) NONE

$$\frac{n_C}{1} = \frac{n_{CO}}{1} \Rightarrow \frac{(1.2/12)}{1} = n_{CO}$$

$n_{CO} = 0.1$ mole

$$\frac{n_{CO}}{1} = \frac{n_{CO_2}}{1}$$

$$\frac{0.1}{1} = n_{CO_2} \Rightarrow n_{CO_2} = 0.1 \text{ mole}$$

Q $2S + 3O_2 \longrightarrow 2SO_3$

$H_2O + SO_3 \longrightarrow H_2SO_4$?

What amount of H_2SO_4 form, when 32 gram sulphur used in Combustion

a) 98g

b) 49g

c) 196g

d) NONE

$$\frac{n_S}{2} = \frac{n_{SO_3}}{2}$$

$$n_{SO_3} = n_S = \frac{32}{32} = 1\text{ mole}$$

$$\frac{n_{SO_3}}{1} = \frac{n_{H_2SO_4}}{1}$$

$$n_{H_2SO_4} = n_{SO_3} = 1\text{ mole}$$

$$W_{H_2SO_4} = 1 \times 98 = 98g$$

Kal ⇒ Stoichiometry Complete → 2 to 3 Case

Limiting Reagent

→ Tatva modules Question

→ NCERT + PYQ →

CASE-02 = percentage yield of Reaction

THANK YOU !!

MANTHAN NEET 2025

SANKALP NEET VEDANTU

HOME WORK Vol-1

Tatva-package → pdf → free

Tatva-package → hard copy

Ex-1 → 86 → 113 Questn

Ex-2 → PYQ Krne hai

Except → Redox Reaction

Normality

CHEMISTRY

Mole concept

Lecture-15



Sarvesh Sir

Topic

stoichiometry

Qsd-1 $2A + 7B \longrightarrow A_2B_7$

What mole of product A_2B_7 form, when 0.1 mole of B react with required amount of A

a) 0.1 mole

b) 0.7 mole

c) $\frac{0.1}{7}$ mole

d) NONE

$$\frac{n_B}{7} = \frac{n_{A_2B_7}}{1}$$

$$n_{A_2B_7} = \frac{0.1}{7} \text{ mole}$$

Qsd-2

$4P + 5O_2 \longrightarrow P_4O_{10}$ (?)

$P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$ → 1 mole

$\frac{?}{2}$

What mole of oxygen gas required to formation of 1 mole ortho phosphoric acid (H_3PO_4)

a) 5 mole

b) 1 mole

c) 3 mole

d) NONE

$\frac{n_{P_4O_{10}}}{1} = \frac{n_{H_3PO_4}}{4}$

$n_{P_4O_{10}} = \frac{1}{4}$ mole

$\frac{n_{O_2}}{5} = \frac{n_{P_4O_{10}}}{1}$

$n_{O_2} = 5 \times n_{P_4O_{10}}$

$= 5 \times \frac{1}{4}$ mole

Case-02 , percentage purity of sample (reactant)

CSD

→ Sample → Compound + other compound
  ↳ inpurity → Koi informahon questⁿ me nahi dete hai

→ Sample $\xrightarrow{\Delta}$ decompose

→ Sample + Reagent → prd
  ↓
  Rxn pure form of comp. Krta hai only

→ theoretically → pure comp. → Calculated

$$\%\ \text{purity} = \frac{\text{Mass of pure Comp}}{\text{Mass of sample}} \times 100$$

$$\text{Mass of Comp} = \frac{\%\ \text{purity}}{100} \times \text{Mass of sample}$$

Q 10 mole lime stone ($CaCO_3$) decompose and form 6 mole of CaO as a product, Calculate percentage purity of sample.

a) 40%

b) 50%

c) 60% ✓

d) 30%

$$\% \text{ purity} = \frac{\text{Mole of } CaCO_3}{\text{Mole of sample}} \times 100$$

$$= \frac{6}{10} \times 100$$

$$= 60\%$$

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

6 mole (CaO)

$$\frac{n_{CaCO_3}}{1} = \frac{n_{CaO}}{1}$$

$$n_{CaCO_3} = 6 \text{ mole}$$

Q 80% pure, 84 gram sample of $MgCO_3$ thermally decompose and form MgO & CO_2 gas. Calulate amount of MgO form

$MgCO_3$

24 + 12 + 48 = 84

$24 + 16 = 40$

a) 32 gram ✓

b) 0.8 gram

c) 3.2 gram

d) NONE

Sample → $MgCO_3$ + impurity

$MgCO_3 \longrightarrow MgO + CO_2$

$\frac{80 \times 84}{100}$ gram

$\frac{80 \times 84}{100 \times 84}$ mole

0.8 mole

$\frac{n_{MgCO_3}}{1} = \frac{n_{MgO}}{1}$

$n_{MgO} = 0.8$ mole

$W_{MgO} = 0.8 \times 40 = 32.0$ gram

Q3. 20.0 g of a magnesium carbonate sample decomposes on heating to give carbon dioxide and 8.0 g magnesium oxide. What will be the percentage purity of magnesium carbonate in the sample? (Atomic weight of Mg = 24) **[CBSE AIPMT 2015]**

(a) 75 (b) 96

(c) 60 (d) 84 ✓

20.0 g → sample

24 + 16 = 40

$$\% \text{ purity} = \frac{\text{Mass of } MgCO_3}{\text{Mass of sample}} \times 100$$

$$= \frac{16.8}{20} \times 100 = 84\%$$

$$MgCO_3 \longrightarrow MgO + CO_2$$

MgO: m.wt = 40, 8.0 gram

$$\frac{n_{MgCO_3}}{1} = \frac{n_{MgO}}{1} = \frac{8/40}{1}$$

$$n_{MgCO_3} = \frac{8}{40} \text{ mole}$$

$$W_{MgCO_3} = \frac{8}{40} \times 84 = 16.8 \text{ g}$$

Case-03 , percentage yields of product

CSD **% yield** = Meaning = Kitne % reaction hue hai

Ex→ **Rxn yield = 60%** → 60% Reactant Convert ho raha hai prd me or 60% reaction ho rahi hai

$$\%\text{ yield of Rxn} = \frac{\text{Exp. Value (prd)}}{\text{theoretical Value (prd)}} \times 100$$

(prd) same comp →
- Exp. value → Questn me di jayegi
- theoretical value → Aap Calculate Karo-ge

Q (10 mole) $CaCO_3$ thermally decompose

$$CaCO_3 \longrightarrow CaO + CO_2$$

What amount of CaO form, if percentage yields of rxn 80%

a) 440 g

b) 448 g ✓

c) 8 gram

d) NONE

$\frac{10 \times 80}{100} = 8$ mole

$\frac{n_{CaCO_3}}{1} = \frac{n_{CaO}}{1}$

$n_{CaO} = 8$ mole

$W_{CaO} = 8 \times 56 = 448$ gram

Q. 4 mole Carbon react with oxygen gas

$\frac{4}{1} = \frac{n_{CO_2}}{1}$

$$\underset{4\,mole}{C} + O_2 \longrightarrow \underset{4\,mole}{CO_2}$$

and form 2 mole of CO_2 gas, what is % yield of Rxn.

(2 mole ← Exp-value)

a) 50%

b) 80%

c) 60%

d) 75%

$$\%\ \text{yield of rxn} = \frac{\text{Exp. Value of } CO_2}{\text{theoretical value of } CO_2} \times 100$$

$$= \frac{2\,mole}{4\,mole} \times 100 = 50\%$$

Q. 14 gram Nitrogen react with oxygen gas

$$2N_2 + 5O_2 \longrightarrow 2N_2O_5$$

and form 0.1 mole of N_2O_5. Calculate % yield of rxn.

Exp value

a) 20%

b) 25%

c) 30%

d) NONE

$$\% \text{ yield of rxn} = \frac{\text{Exp. value of } N_2O_5}{\text{theoretical value of } N_2O_5} \times 100 = \frac{0.1}{\frac{1}{2}} \times 100$$

$$= 20\%$$

$$\frac{n_{N_2}}{x} = \frac{n_{N_2O_5}}{x}$$

$$\frac{\frac{14}{28}}{x} = \frac{n_{N_2O_5}}{x}$$

$$n_{N_2O_5} = \frac{1}{2} \text{ mole}$$

Q → $N_2 + \frac{1}{2}O_2 \longrightarrow N_2O$ (50% yield)

$2N_2O + 4O_2 \longrightarrow 2N_2O_5$ (80% yield)

What mole of N_2O_5 form, when Rxn start by 1 mole of N_2

(NEET → Abhi TK nahi aaya hai)

a) 0.5 mole

✓ b) 0.4 mole

c) 0.25 mole

d) NONE

$N_2 + \frac{1}{2}O_2 \longrightarrow N_2O$

$\frac{1 \times 50}{100} = 0.5$ mole   0.5 mole

$2N_2O + 4O_2 \longrightarrow 2N_2O_5$

$0.5 \text{ Mole} \times \frac{80}{100} = \frac{4}{10} = 0.4$ mole

Q $S + O_2 \rightarrow SO_2$ (40% yield)

$\frac{4 \times 40}{100} = 1.6$ mole

SO_2: 1.6 mole

$SO_2 + H_2O \rightarrow H_2SO_3$ (50% yield)

1.6 mole

What mole of H_2SO_3 form, when 4 mole of 'S' used initially

a) 1.6 mole

b) 3.2 mole

c) 0.8 mole

d) 0.4 mole

$\frac{1.6 \times 50}{100} = 0.8$ mole

$\frac{n_{SO_2}}{1} = \frac{n_{H_2SO_3}}{1}$

$n_{H_2SO_3} = 0.8$ mole

Case-04, mixture react with reagent

Csd Sample → yadi sample me 2-Comp. ⇒ usi sample ko mixture bola diya jata hai

Mixture —
- → Comp-1 → name diye jayenge
- → Comp-2 → name diye jayenge

Comp-1 or Comp-2 + Reagent →

Comp-1 + Comp-2 + Reagent →

Q 10 mole ore of Cu (suppose only Cu & Zn present) react with dil HCl and 4 mole H_2 gas. (only Cu react with HCl)

$$Cu + 2HCl \longrightarrow CuCl_2 + H_2$$

Calculate Composition of mixture or ore

$$\frac{n_{Cu}}{1} = \frac{n_{H_2}}{1}$$

$n_{Cu} = 4$ mole

$n_{Zn} = 10 - 4 = 6$ mole

Q 10 mole mixture of Na_2CO_3 and $MgCO_3$ thermally heated and form 44.8 litre CO_2 gas at S.T.P., Na_2CO_3 is thermally stable comp. Calculate mole of Na_2CO_3 in mixture ↓

a) 2 mole
b) 8 mole
c) 4 mole
d) 6 mole

$$MgCO_3 \rightarrow MgO + CO_2$$

$$\frac{n_{MgCO_3}}{1} = \frac{n_{CO_2}}{1}$$

$$n_{MgCO_3} = \frac{44.8}{22.4} = 2\ mole$$

$$n_{Na_2CO_3} = 10 - 2 = 8\ mole$$

1st grp → CO_3^{-2}, SO_4^{-2}, OH^-

44.8 Litre at S.T.P

thermally stable hota hai → C.O.S.

Except → Li-C.O.S.

Case-05, if value of more than one reactant given (LIMITING REAGENT)

THANK YOU !!

MANTHAN NEET 2025

$\frac{20}{50} \times 100 = 40\%$

23 June → Re-exam → 1563

Chemistry = 50

P.C. = 20 → Notes or CSD

O.C = 15

IOC = 15

CHEMISTRY

Mole concept

Lecture-16



Sarvesh Sir

Next test Ka syllabus

Complete mole Concept

Topic

stoichiometry

Qsd-1

$N_2 + 3H_2 \longrightarrow 2NH_3$ (given: H_2; ?: NH_3)

What amount of NH_3 form by 1 gram of H_2 react with required amount of N_2.

a) 17 gram
b) $\frac{1}{3}$ gram
c) $\frac{17}{3}$ gram
d) NONE

$\frac{1}{2}$ mole of H_2

$\frac{n_{H_2}}{3} = \frac{n_{NH_3}}{2}$

$n_{NH_3} = \frac{2}{3} \times n_{H_2} = \frac{2}{3} \times \frac{1}{2} = \frac{1}{3}$ mole

$W_{NH_3} = \frac{1}{3} \times 17$ gram

2 mole

QSD-2 - A ⟶ B (% YIELD -80)

B ⟶ 2D (% YIELD -50),

calculate mole of D form, if 2 mole of A initially taken in chemical reaction

(A) 1.6 mole

(B) 0.8 mole

(C) 3.2 mole

(D) None

$\frac{?}{2}$

$\frac{2 \times 80}{100} = \frac{8}{5} = 1.6$

$A \longrightarrow B$

2 mole

2-1.6 mole 1.6 mole

$B \longrightarrow 2D$

1.6-0.8 2×0.8

= 1.6 mole

Case-05, if value of more than one reactant given
(LIMITING REAGENT)

CSD ⇒ If more than one Reactant = given in Question (value)

Step-1 → Rxn - likho & Balance Karo

$$n_1A + n_2B \longrightarrow n_3C$$

Step-2 → given information → Convert into mole

Step-3 → Check → limiting Reagent = $\left(\frac{\text{Mole}}{\text{Stoi. Coeff.}}\right)$ Ratio → Smallest ratio ⇒ L.R.

Step-4 → $\left(\frac{\text{Mole}}{\text{St. Ceo.}}\right)_{L.R.} = \left(\frac{\text{Mole}}{\text{St. Ceo.}}\right)$ findout

Q → $_H_2 + _Cl_2 \longrightarrow 2HCl$

H_2	Cl_2	HCl	
2 mole	5 mole	0	t=0
2-2	5-2	4	
0	3	4	
0	3 mole	(4 mole)	

Jo pahele Khatam ho jata hai → Liminting Reagent (L.R.)

Jo Bach jata hai = Excess Reagent (E.R)

Q → $N_2 + O_2 \longrightarrow N_2O_2$

(L.R. over N_2, E.R. over O_2)

4 mole 7 mole = ?

L.R. ← $\left(\frac{4}{1}\right)$ $\left(\frac{7}{1}\right)$

L.R. = H_2

E.R. = O_2

Q → $2H_2 + O_2 \longrightarrow 2H_2O$

(L.R. over H_2, E.R. over O_2)

2 mole 4 mole = ?

$\left(\frac{2}{2}\right) = 1$ $\frac{4}{1} = 4$

Q → $N_2 + 3H_2 \longrightarrow 2NH_3$ L.R. = H_2

14g 2gram = ? E.R. = N_2

$\frac{14}{28} = \frac{1}{2}$ mole $= 0.5$ $\frac{2}{2} = 1$ mole

→ E.R. → L.R.

$\left(\frac{0.5}{1}\right) = 0.5$ $\frac{1}{3} = 0.33$ $= 0.33$

Q. 10g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be:

NEET-P.Y.Q.

A. 2 moles

B. 3 moles

C. 4 moles ✓

D. 1 mole

$2H_2 + O_2 \longrightarrow 2H_2O$ (L.R. → O_2)

10g   64g

$\frac{10}{2} = 5$ mole $\frac{64}{32} = 2$ mole

Check → L.R. = $\left(\frac{5}{2}\right) = 2.5$ $\left(\frac{2}{1}\right) = 2$

$\frac{n_{O_2}}{1} = \frac{n_{H_2O}}{2}$

$\frac{2}{1} = \frac{n_{H_2O}}{2}$

$n_{H_2O} = 4$ mole

Q6. When 22.4 L of $H_2(g)$ is mixed with 11.2 L of $Cl_2(g)$, each at STP, the moles of HCl(g) formed is equal to **[CBSE AIPMT 2014]**

(a) 1 mole of HCl(g)
(b) 2 moles of HCl(g)
(c) 0.5k mole of HCl(g)
(d) 1.5 moles of HCl(g)

$H_2 + Cl_2 \longrightarrow 2HCl$ (Cl_2 → L.R.)

22.4L 11.2L

$\frac{22.4}{22.4} = 1\text{mole}, \quad \frac{11.2}{22.4} = 0.5\text{mole}$

Check → L.R. $\frac{1}{1} = 1 \quad \frac{0.5}{1} = 0.5$

$\frac{n_{Cl_2}}{1} = \frac{n_{HCl}}{2}$

$\frac{0.5}{1} = \frac{n_{HCl}}{2}$

$n_{HCl} = 0.5 \times 2 = 1\text{mole}$

Q. In the reaction

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l)$

When 1 mole of ammonia and 1 mole of O_2 are made to react to completion, then

$\left(\frac{1}{4}\right)$ $\left(\frac{1}{5}\right)$ → smallest → L.R.

A. 1.0 mole of H_2O is produced ✗

B. 1.0 mole of NO will be produced ✗

C. all the oxygen will be consumed ✓

D. all the ammonia will be consumed ✗

$\frac{1}{5} = \frac{n_{H_2O}}{6}$

$n_{H_2O} = \frac{6}{5}$ mole

$\frac{1}{5} = \frac{n_{NO}}{4}$

$n_{NO} = \frac{4}{5}$ mole

Q3. 20.0 g of a magnesium carbonate sample decomposes on heating to give carbon dioxide and 8.0 g magnesium oxide. What will be the percentage purity of magnesium carbonate in the sample? (Atomic weight of Mg = 24) [CBSE AIPMT 2015]

(a) 75 (b) 96

(c) 60 (d) 84

Q. In Harber process 30 L of dihydrogen and 30 L of dinitrogen were taken for reaction which yielded only 50% of the expected product. What will be the composition of gaseous mixture under the aforesaid condition in the end?

3 1

A 20 L ammonia, 10 L nitrogen, 30 L hydrogen

B 20 L ammonia, 25 L nitrogen, 15 L hydrogen

C 20 L ammonia, 20 L nitrogen, 20 L hydrogen

D 10 L ammonia, 25 L nitrogen, 15 L hydrogen

L.R.

$3H_2 + N_2 \longrightarrow 2NH_3$

30L 30L 0 t=0

$\frac{30/22.4}{3}$ $\frac{30/22.4}{1}$

30-15 30-5 10L

15L 25L 10L

$3H_2 + N_2 \longrightarrow 2NH_3$

30L	30L	
30-45	30-15	
	15L	

Wrong ho gaya

$3H_2 + N_2 \longrightarrow 2NH_3$

30L	30L	0
30-15	30-5	
15L	25L	10L

$$\frac{n_{H_2}}{3} = \frac{n_{NH_3}}{2}$$

$$\frac{15}{3} = \frac{n_{NH_3}}{2}$$

$$n_{NH_3} = \frac{15}{3} \times 2 =$$

Q. 1.0 g of magnesium is burnt with 0.56 g of oxygen in a closed vessel. Which reactant if left in excess and how much? (At weight of Mg = 24, O = 16) NEET→PYQ

E.R: Remaining amount of L.R. = 1 − 0.84 = 0.16 g

(A) Mg, 0.16g

(B) O_2, 0.16g

(C) Mg, 0.44g

(D) O_2, 0.28g

E.R → $2Mg + O_2 \rightarrow MgO$ ← L.R.

1 g 0.56 g

$\frac{1}{24}$ mole $\frac{0.56}{32}$ mole

Check → L.R. $\frac{1/24}{2} = \frac{1}{48}$ $\frac{0.56/32}{1}$

$\frac{n_{O_2}}{1} = \frac{n_{Mg}}{2}$

$\frac{\frac{0.56}{32}}{1} = \frac{n_{Mg}}{2}$

$n_{Mg} = \frac{0.56}{32} \times 2$ mole

$W_{Mg} = \frac{0.56}{32} \times 2 \times 24$ gram

$= 0.84$ gram

Volume strength of H_2O_2

H_2O_2 = unstable liquid

$$2H_2O_2(l) \longrightarrow 2H_2O(l) + O_2(g)$$

1 litre

"total volume of O_2 gas release at S.T.P. By 1 litre of liquid H_2O_2 decompose is Know as Vol. Strength of H_2O_2."

Q→ 500ml liquid H_2O_2 decompose and release 5 litre O_2 gas at S.T.P., Cal. vol. strength of H_2O_2

a) 5L

b) 10L ✓

c) 2.5L

d) NONE

1 litre H_2O_2 ⟶ Vol. of O_2 gas at S.T.P.

500ml = $\frac{1}{2}$ litre = 5L

1 litre H_2O_2 = 5×2 = **10L**

$$2H_2O_2\,(l) \longrightarrow 2H_2O(l) + O_2\,(g)$$

→ 1 litre $\qquad\qquad$ V Litre at S.T.P.

$\frac{V}{22.4} \times 2$ mole $\qquad\qquad$ $\frac{V}{22.4}$ mole

Molarity of H_2O_2 liquid $(M_{H_2O_2}) = \frac{n_{H_2O_2}}{V_{soln}(L)} = \frac{\frac{V}{11.2}}{1}$

$$M_{H_2O_2} = \frac{V}{11.2} = \frac{\text{Vol. Strength}}{11.2}$$

gram/ litre strength of H_2O_2 = $M_{H_2O_2} \times$ M·wt of H_2O_2 $\frac{g}{L}$

(↑ $\frac{\text{mole}}{\text{litre}}$)

$$= \frac{V}{11.2} \times 34 = \frac{34V}{11.2} \frac{\text{gram}}{\text{litre}}$$

Normality of H_2O_2 = $n_{H_2O_2} \times M_{H_2O_2} = 2 \times \frac{V}{11.2} = \frac{V}{5.6}$

***

C_{SD} → total vol. of O_2 gas at S.T.P. release by decomposition of 1 litre liquid H_2O_2 = Volume strength of H_2O_2

→ $M_{H_2O_2} = \frac{\text{Vol. strength of } H_2O_2 (V)}{11.2}$

→ g/L strength of $H_2O_2 = \frac{34V}{11.2}$

→ Normality of $H_2O_2 = \frac{V}{5.6}$

13:3

$$H_2O_2 \rightleftharpoons H^+ + HO_2^-$$

$$HO_2^- \rightleftharpoons H^+ + O_2^{-2}$$

└ peroxide

$$n_{H_2O_2} = 2$$

THANK YOU !!

MANTHAN NEET 2025



CHEMISTRY

Mole concept

Lecture-17



Sarvesh Sir

Topic

volume strength of H_2O_2

law of chemical combination

Q3. 20.0 g of a magnesium carbonate sample decomposes on heating to give carbon dioxide and 8.0 g magnesium oxide. What will be the percentage purity of magnesium carbonate in the sample? (Atomic weight of Mg = 24) [CBSE AIPMT 2015]

(a) 75 (b) 96

(c) 60 (d) 84

Qsd-1

Problem 1.3

Calculate the amount of water (g) produced by the combustion of 16 g of methane.

(A) 4 gram

(B) 18 gram

(C) 1.8 gram

~~(D)~~ NONE

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

$$\frac{16g}{16} = 1 \text{ mole}$$

$$\frac{1}{1} = \frac{n_{H_2O}}{2}$$

$$n_{H_2O} = 2 \text{ mole}, \quad W_{H_2O} = 2 \times 18 = 36g$$

Qsd-2

Ques -

2246
252

Problem 1.5

50.0 kg of N_2 (g) and 10.0 kg of H_2 (g) are mixed to produce NH_3 (g). Calculate the amount of NH_3 (g) formed. Identify the limiting reagent in the production of NH_3 in this situation.

(A) (a) → N_2, 17g
(B) (b) → H_2, 17g
(C) → N_2, 34g
(d) → NONE

$N_2 + 3H_2 \longrightarrow 2NH_3$ (3 H_2 → L.R.)

50×10^3 g, 10×10^3 g

$\frac{50\times10^3}{28}$ mole, $\frac{10\times10^3}{2}$ mole

Check → L.R. $\frac{1.7\times10^3 \text{ mole}}{1}$, $\frac{5\times10^3}{3} = 1.67\times10^3$

$\frac{n_{H_2}}{3} = \frac{n_{NH_3}}{2}$

$\frac{5\times10^3}{3} = \frac{n_{NH_3}}{2}$

$n_{NH_3} = \frac{10\times10^3}{3}$ mole

$W_{NH_3} = \frac{10\times10^3\times17}{3}$

$= \frac{170\times10^3}{3}$

$= \frac{170}{3}$ Kg

CSD

→ <u>Volume strength of H_2O_2</u> = Vol. of O_2 gas release at S.T.P by decomposition of 1 litre of liquid H_2O_2.

→ Molarity of H_2O_2 = $\frac{\text{Vol. strength}}{11.2}$ $\left(\frac{\text{mole}}{\text{litre}}\right)$

→ g/L Strength of H_2O_2 = $\frac{34 \times \text{Vol. strength}}{11.2}$

→ Normality of H_2O_2 = $n_{H_2O_2} \times M_{H_2O_2}$ = $\frac{2 \times \text{Vol. strength}}{11.2}$

Q → 1 litre liquid H_2O_2 decompose and release 10 litre O_2 gas at S.T.P., Calculate molarity of H_2O_2 liquid.

Vol. strength of H_2O_2

a) 0.1 M

b) 0.3 M

c) $\frac{10}{5.6}$ M

d) $\frac{10}{11.2}$ M ✓

$$M_{H_2O_2} = \frac{\text{Vol. strength}}{11.2}$$

$$= \frac{10}{11.2}$$

Q. gram/Litre strength of H_2O_2 is 3.4 g/L. Calculate Volume strength of H_2O_2 liquid

a) 11.2

b) 112

~~c)~~ 1.12

d) NONE

$$g/L \text{ strength of } H_2O_2 = \frac{34 \times \text{Vol. strength}}{11.2}$$

$$\overset{0.1}{\cancel{34}} = \frac{\cancel{34} \times \text{Vol. strength}}{11.2}$$

Vol. strength = 1.12

Problem 1.4

How many moles of methane are required to produce 22g CO_2 (g) after combustion?

(A) H.W:

(B)

(C)

(D)

Ques –

Problem 1.6

A solution is prepared by adding 2 g of a substance A to 18 g of water. Calculate the mass per cent of the solute.

(A) 5%

(B) 9%

(C) 15%

(D) NONE

$$\text{Mass \% of solute} = \frac{W_{solute}}{W_{soln}} \times 100$$

$$= \frac{2}{20} \times 100 = 10\%$$

Ques -

Problem 1.8

The density of 3 M solution of NaCl is 1.25 g mL^{-1}. Calculate the molality of the solution.

(A)

(B)

(C)

(D)

Ques -

1.4 Calculate the amount of carbon dioxide that could be produced when

(i) 1 mole of carbon is burnt in air.

(ii) 1 mole of carbon is burnt in 16 g of dioxygen.

H.W. → (iii) 2 moles of carbon are burnt in 16 g of dioxygen.

(A)

(B)

(C)

(D)

(i) $C + O_2 \rightarrow CO_2$

1 mole

$n_{CO_2} = 1$ mole

$W_{CO_2} = 1 \times 44 = 44g$

(ii) $C + O_2 \rightarrow CO_2$ (O_2 → L.R.)

1 mole, $\frac{16g}{32}$

1 mole, 0.5 mole

Check L.R. $\frac{1}{1}$, $\frac{0.5}{1}$

$n_{CO_2} = 0.5$ mole, $W_{CO_2} = 0.5 \times 44 = 22g$

(iii)

$HNO_3 \rightarrow 1+14+48=63$

Ques – 1.6 Calculate the concentration of nitric acid in moles per litre in a sample which has a density, 1.41 g mL^{-1} and the mass per cent of nitric acid in it being 69%. (w/w)

d_{soln}

(A) 8.1 M

(B) 0.75 M

(C) 1.35 M

~~(D)~~ NONE

$$M = \frac{n_{solute}}{M_{soln}} \times d_{soln}\left(\frac{g}{ml}\right) \times 10^3$$

$$= \frac{(69/63)}{100} \times 1.41 \times 1000$$

$$= \frac{69 \times 14.1}{63} = \underline{15.44}\ M$$

(iii) Number of molecules of ethane.

1.11 What is the concentration of sugar ($C_{12}H_{22}O_{11}$) in mol L^{-1} if its 20 g are dissolved in enough water to make a final volume up to 2L?

Ques

NEET ****

1.12 If the density of methanol is 0.793 kg L^{-1}, what is its volume needed for making 2.5 L of its 0.25 M solution?

(A)

(B)

(C)

(D)

Soln → 1.11.

$$M = \frac{n_{solute}}{V_{soln}(L)}$$

C → 12
H → 4
O → 16
32

$$= \frac{(20/342)}{2} = \frac{20}{342 \times 2}$$

$$\frac{10}{342} = 0.0292\,M$$

Soln - 1.12 → $V_{soln} = 2.5\,L$

$$V_{CH_3OH} + V_{H_2O} = 2.5\,L$$

Mole of solute (CH_3OH) = 2.5×0.25
= 0.625 mole

$W_{CH_3OH} = 0.625 \times 32\,g$
= 20 gram

$d = \frac{M}{V}$, $V_{CH_3OH} =$

$$d = \frac{M}{V}$$

$$V = \frac{M}{d} = \frac{20 \times 10^{-3}\ \cancel{Kg}}{0.793\ \frac{\cancel{Kg}}{L}}$$

$$= \frac{20 \times 10^{-3}}{0.793}\ \text{Litre}$$

$$= 25.2 \times 10^{-3}\ L = \boxed{0.025\ L}$$

Ques

1.23 In a reaction

$A + B_2 \rightarrow AB_2$

Identify the limiting reagent, if any, in the following reaction mixtures.

(i) 300 atoms of A + 200 molecules of B → B_2

(ii) 2 mol A + 3 mol B → A

(iii) 100 atoms of A + 100 molecules of B → H.W.

(iv) 5 mol A + 2.5 mol B → H.W

(v) 2.5 mol A + 5 mol B → H.W

**** NEET

(A)

(B)

(C)

(D)

1) $A + B_2 \rightarrow AB_2$ (B_2 → L.R)

300 atoms of A + 200 molecules of B

$$\frac{\frac{300}{N_A}\text{ mole}}{1} \qquad \frac{\frac{200}{N_A}\text{ mole}}{1} \rightarrow \text{L.R}$$

(ii) 2 mole A + 3 mole B

$$\frac{2}{1} \rightarrow \text{L.R} \qquad \frac{3}{1}$$

Ques - NEET-2025

1.24 Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation:

$N_2 (g) + H_2 (g) \rightarrow 2NH_3 (g)$

(i) Calculate the mass of ammonia produced if 2.00×10^3 g dinitrogen reacts with 1.00×10^3 g of dihydrogen.

(ii) Will any of the two reactants remain unreacted? → H_2 → E.R.

(iii) If yes, which one and what would be its mass?

(A)

(B)

(C)

(D)

$N_2 + 3H_2 \longrightarrow 2NH_3$ (N_2 → L.R.; NH_3 → $w = ?$)

(i) 2×10^3 g 1×10^3 g

$\frac{2 \times 10^3}{28}$ mole $\frac{1 \times 10^3}{2}$ mole

Check L.R. $\frac{\frac{2}{28} \times 10^3}{1}$ $\frac{\frac{1}{2} \times 10^3}{3} = \frac{1}{6} \times 10^3$

$\frac{n_{N_2}}{1} = \frac{n_{NH_3}}{2}$

$n_{NH_3} = \frac{2 \times 10^3}{28} \times 2 = \frac{1}{7} \times 10^3$ mole

$W_{NH_3} = \frac{1}{7} \times 17 \times 10^3 = 2.4 \times 10^3$ g

$$\frac{n_{N_2}}{1} = \frac{n_{H_2}}{3}$$

$$\frac{2\times10^3}{28} = \frac{n_{H_2}}{3}$$

$$n_{H_2} = \frac{3\times2\times10^3}{28}$$

$$W_{H_2} = \frac{3\times2\times10^3\times2}{28} \text{ gram}$$

$$W_{\text{unreacted } H_2} = 1\times10^3 - \frac{3\times4}{28}\times10^3$$

$$= \frac{16}{28}\times10^3 \text{ gram}$$

(i) empirical formula, (ii) molar mass of the gas, and (iii) molecular formula.

1.35 Calcium carbonate reacts with aqueous HCl to give $CaCl_2$ and CO_2 according to the reaction, $CaCO_3$ (s) + 2 HCl (aq) → $CaCl_2$ (aq) + CO_2(g) + H_2O(l)

What mass of $CaCO_3$ is required to react completely with 25 mL of 0.75 M HCl?

1.36 Chlorine is prepared in the laboratory by treating manganese dioxide (MnO_2) with aqueous hydrochloric acid according to the reaction

H.W. → 4 HCl (aq) + MnO_2(s) → $2H_2O$ (l) + $MnCl_2$(aq) + Cl_2 (g)

How many grams of HCl react with 5.0 g of manganese dioxide?

Ques

(A) Sol^n 1.35

(B) $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$ (? , given)

(C) ↓

(D) W = ? 25 ml, 0.75 M HCl sol^n

$= 0.75 \times 25 \times 10^{-3}$ mole HCl

$$\frac{n_{CaCO_3}}{1} = \frac{n_{HCl}}{2}$$

$$n_{CaCO_3} = \frac{0.75 \times 25 \times 10^{-3}}{2} \text{ mole}$$

$$W_{CaCO_3} = \frac{0.75 \times 25 \times 10^{-3}}{2} \times 100 \text{ gram}$$

$$\frac{1.875}{2} g = 0.9375 \text{ gram}$$

1 mole = 0.5 mole → 2×0.5 mole = 1 mole

+5 / −5

Ques - $A \longrightarrow 2B$ (% yield = 50%)

$\frac{1 \times 20}{100}$ = 0.2 mole

$B \longrightarrow 3C$ (% yield = 20%) → $0.2 \times 3 = 0.6$ mole

1 mole

(A)
(B)
(C)
(D)

What mole of 'c' form, If initially 1 mole of A required in Rxn.

a) 0.5 mole

b) 0.6 mole → 70% → +5

c) 0.4 mole 30% → −5

40% → +5

d) NONE

THANK YOU !!

Compete mole Concept → 5Qsd

MANTHAN NEET 2025

5 Quest^n → Qsd

CHEMISTRY

Mole concept

Lecture-18



Sarvesh Sir

Topic

law of chemical combination

Qsd-1

molecule (O_2)

Q48. 8g of oxygen has the same number of molecules as in-

$\frac{8}{32} = \frac{1}{4}$ mole $= \frac{1}{4} \times N_A$

NEET-2023 (Re-exam)

✓ (A) 11 g CO_2 → $\frac{11}{44} = \frac{1}{4} \times N_A$

✗ (B) 22 g CO_2 →

✗ (C) 8 g CO → $\frac{8}{28} = \frac{4}{14} = \frac{2}{7}$

✗ (D) 14 g CO → $\frac{14}{28} = \frac{1}{2}$ mole

Psd-2

$N_2 + O_2$
$x\%$ $(100-x)\%$

Q37. If average molecular wt. of air is 29, then assuming N_2 and O_2 gases are there which options are correct composition of air:

(i) 75% by mass of N_2

(ii) 75% by moles N_2

(iii) 72.41% by mass of N_2

(A) Only (i) is correct

(B) Only (ii) is correct

(C) Both (ii) and (iii) are correct

(D) Both (i) and (ii) are correct

$M_{avg} = 29$

$$M_{avg} = \frac{M_1 x_1 + M_2 x_2}{x_1 + x_2}$$

$$29 = \frac{28 \times x + 32(100-x)}{x + 100 - x}$$

$$2900 = 28x + 3200 - 32x$$

$$-300 = -4x \Rightarrow x = \frac{300}{4} = 75\%$$

Qsd-3

$4L = 4$ mole HCl $\quad 1L = 2$ mole HCl

Q45. 1 M HCl and 2M HCl are mixed in volume ratio of 4 : 1 what is the final molarity of HCl solution?

5 litre

(A) 1.5

(B) 1

(C) 1.2

(D) 1.8

$$M_{HCl} = \frac{n_{HCl}}{\text{Vol. of soln (L)}} = \frac{4+2}{5 \text{ litre}} = \frac{6}{5} = 1.2\,M$$

$$\text{Mole} = M \times V$$

Qsd-4

$0.1 \times V$ mole $AgNO_3 = 0.1V$ mole NO_3^-

Q50. Equal volumes 0.1 M $AgNO_3$ and 0.2 M NaCl are mixed. The concentration of NO_3^- ions in the mixture will be

(A) 0.1 M

(B) 0.05 M

(C) 0.2 M

(D) 0.15 M

$$M_{NO_3^-} = \frac{n_{NO_3^-}}{\text{Vol. of soln (L)}} = \frac{0.1 \times V}{V+V} = \frac{0.1 \times V}{2V}$$

$$= \frac{0.1}{2} = 0.05\,M$$

Qsd = 5

****

Q62. What amount of $CaCO_3$ required to product 11.2 litre CO_2 on decomposition at STP, if sample of $CaCO_3$ is of 60% purity :

(A) 60.5 gm

(B) 30.2 gm

(C) 83.3 gm

(D) 67.1 gm

$$CaCO_3 \longrightarrow CaO + CO_2$$

0.6w g 11.2 litre

sample = w

$$W_{CaCO_3} = \frac{w \times 60}{100} = 0.6w \text{ gram}$$

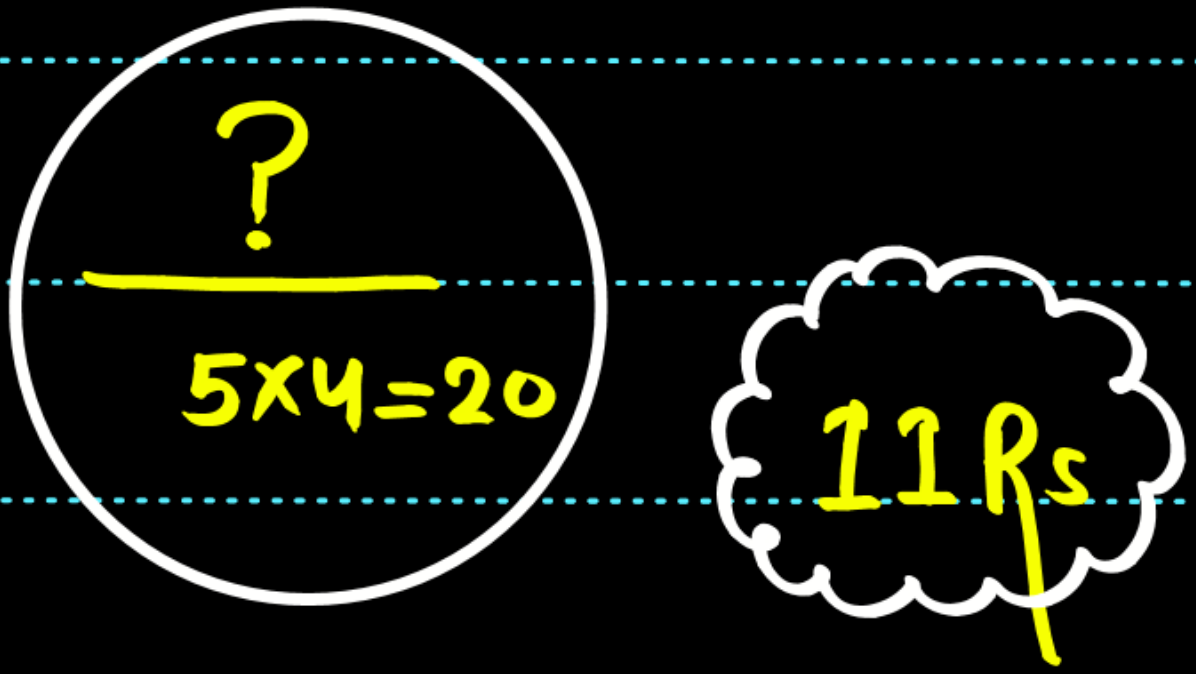
$$\frac{n_{CaCO_3}}{1} = \frac{n_{CO_2}}{1}$$

$$\frac{0.6w/100}{1} = \frac{11.2/22.4}{1} = \frac{1}{2}$$

$$\frac{0.6w}{100} = \frac{1}{2}$$

$$w = \frac{1000}{2 \times 0.6} = \frac{250}{3}$$

$$w = 83.34 \text{ g}$$


?
5x4=20
11Rs

1. Laws of conservation of mass

In all chemical reaction mass neither be create nor be destroyed

$$\underbrace{HCl + NaOH}_{L.H.S.} \longrightarrow \underbrace{NaCl + H_2O}_{R.H.S.}$$

* Balance Rxn → Karo
* Nuclear Rxn → x (Radioactive decay)

Q 10 gram of A react with 15 gram of B and form 5 gram A_2B and x gram AB. find out value of x

$$3A + 2B \longrightarrow A_2B + AB$$

10g   15g   5g   x g

$$10 + 15 = 5 + x$$

$$x = 25 - 5 = 20g$$

Q $HCl + NaOH \rightarrow NaCl + H_2O$

1 mole of HCl react with 1 mole of NaOH and form

23
35.5
1 mole NaCl, If above rxn follows law of Conversation of mass, than calculate amount of water form

a) 180g
b) 18g
c) 1g
d) NONE

$$W_{HCl} + W_{NaOH} = W_{NaCl} + W_{H_2O}$$

$$36.5g + 40g = 58.5 + W_{H_2O}$$

$$W_{H_2O} = 76.5 - 58.5 = 18.0g$$

13:3

2. Laws of definite or constant proportion

A chemical compound always contains same element with fixed proportion by mass , it does not depent upon source and method of preparation it has been obtained

C : O

(M-1) $C + O_2 \rightarrow CO_2 \rightarrow 12 : 32 \rightarrow 3:8$

(M-2) $CO + \frac{1}{2}O_2 \rightarrow CO_2 \rightarrow 12 : 32 \rightarrow 3:8$

(M-3) $CaCO_3 \rightarrow CO_2 + CaO$ $12 : 32 \rightarrow 3:8$

Q In an Experiment 2.4 gram iron oxide an reduction with Hydrogen yield 1.68 gram of iron. In another Experiment 2.9 gram of iron oxide given 2.03 gram of iron on reduction with Hydrogen. Show that the above data illustrate the law of Const proportions.

$$2.90 - 2.03 = 0.87$$

$$2.40 - 1.68 = 0.72$$

Fe : O → Mass ratio fixed hona chahiye

Exp-1 → $\frac{1.68}{0.72} : \frac{0.72}{0.72}$

→ $(2.33 : 1) \times 3$

→ $(7 : 3)$

Exp-2 Fe : O

$\frac{2.03}{0.87} : \frac{0.87}{0.87}$

$= (2.33 : 1) \times 3$

$7 : 3$

Q. A & B form by source-1, A = 4g, B = 6g

A & B form by source-2, A = 15g, B = 22.5g

above data follows the law of Const. proportion

a) Yes

b) NO

c) Can not say

d) NONE

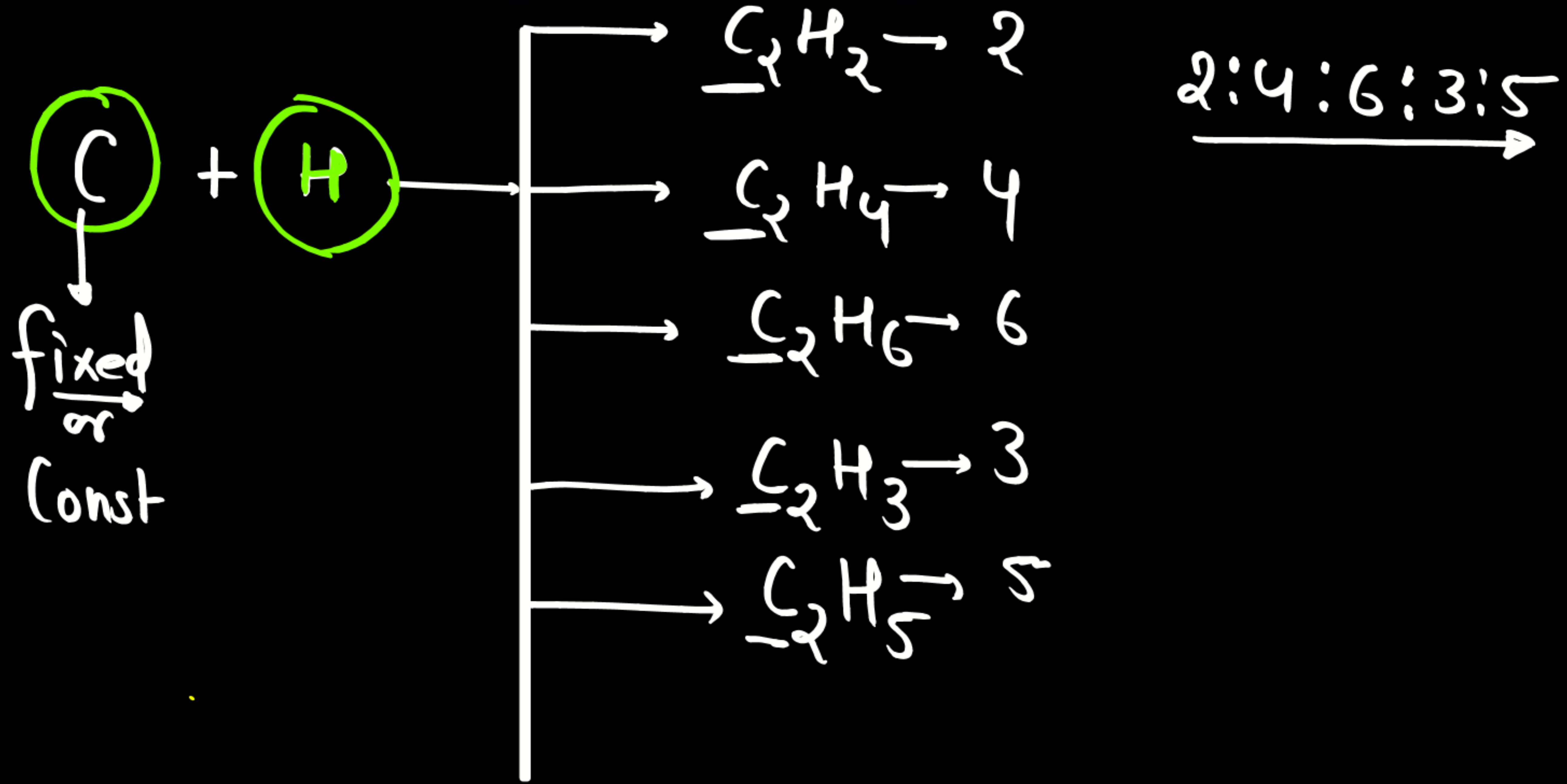
Exp-1 ⇒ A : B → 4 : 6 = 2 : 3

Exp-2 ⇒ A : B → $\frac{15}{15} : \frac{22.5}{15}$ = 1 : 1.5

= 2 : 3

3. Laws of multiple proportion

When different masses of one element combine with a fixed mass of other element and form different compound , bear a simple ratio of one other



$U + O \rightarrow$	O	U
$U_2O_3 \rightarrow 3\times16$	1	$\frac{2}{3}$
$U_2O_5 \rightarrow 5\times16$	1	$\frac{2}{5}$
$U_2O_7 \rightarrow 7\times16$	1	$\frac{2}{7}$

U_2 ↓ fixed

$3:5:7$

$\frac{\cancel{2}}{3} : \frac{\cancel{2}}{5} : \frac{\cancel{2}}{7}$

$\leftarrow \frac{(35 : 21 : 15)}{3\times5\times7}$

Ex → N_2O_3 , N_2O_4 , N_2O_5

3 : 4 : 5

a) yes

b) NO

Ex → Na_2O , MgO ,

a) yes

b) NO

Ex → CO , CO_2 , C_3O_2

C_3O_3 C_3O_6 C_3O_2

→ 3 : 6 : 2

C_2O_3 CO_2 C_3O_2

2 : 1 : 3

Q. Carbon combine with Hydrogen to form 2 compounds A & B, the % of Hydrogen in A & B are 25% and 14.3% respectively. ? proof that above data follows law of multiple proportion.

$C + H \rightarrow$

(A) $\rightarrow H = \frac{25\%}{25}, C = \frac{75\%}{25} \Rightarrow$

(B) $\rightarrow H = \frac{14.3\%}{14.3}, C = \frac{85.7\%}{14.3} \Rightarrow$

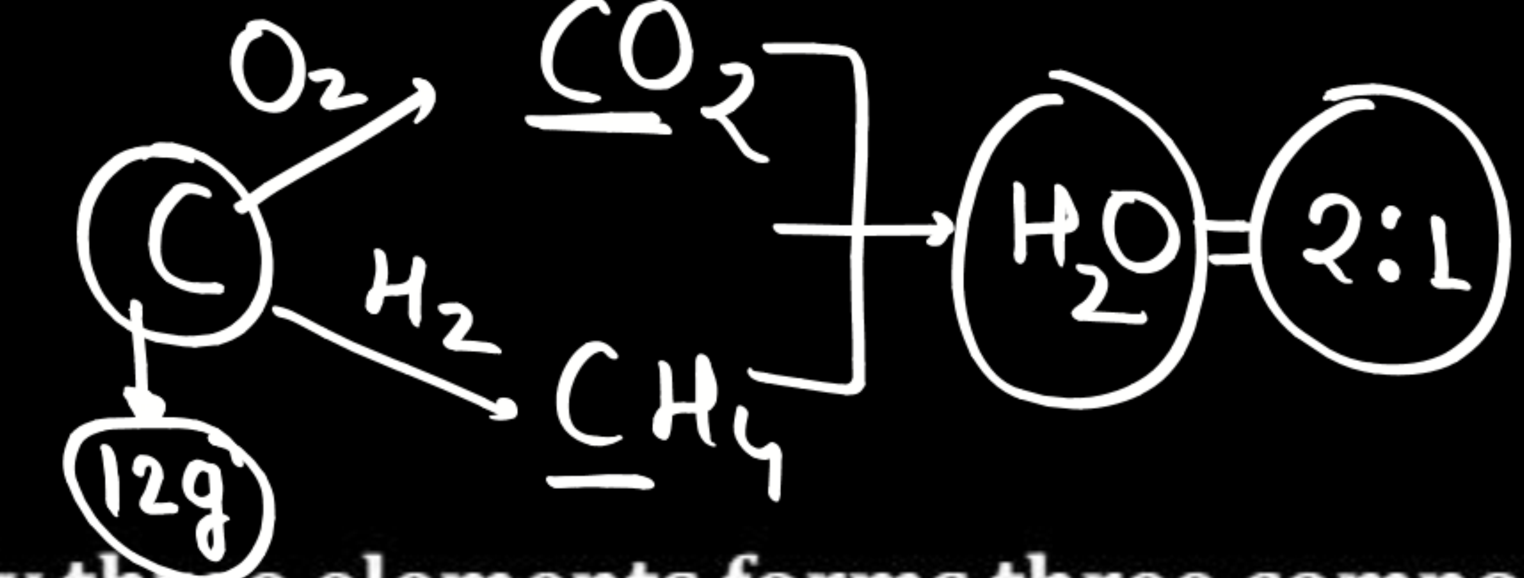
H		C
1	:	3
1	:	5.99
1	:	6

$C \rightarrow 3:6 = 1:2$

4.Law of Reciprocal proportion

Proposed by Ritcher.

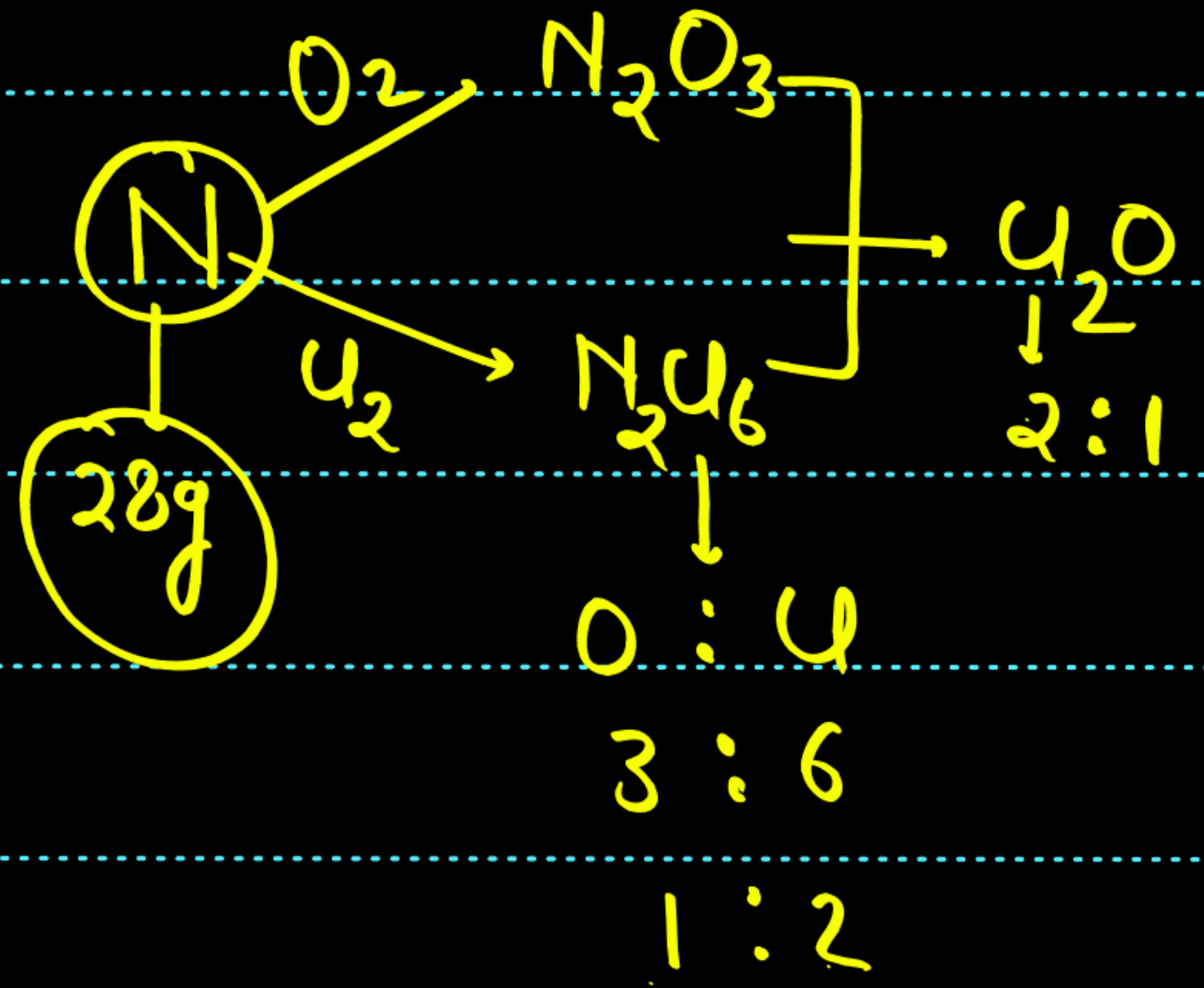
- When 2 elements combine with fixed mass of 3rd element than the ration of mass in which they of combine with each other are same or simple whole no. multiple.



Trick.

(1) Only three elements forms three compounds.

(2) One elements is common in two compounds only.


N
28g
O2
H2
N2O3
N2H6
H2O
2 : 1
O : H
3 : 6
1 : 2

Q. KCl contains 52% 'K', KI contains 23.6% 'K' and ICl contains 78.2% iodine (I_2). Show the law of Reciprocal.?

Sol^n

K (fixed)

K —Cl→ KCl, K —I→ KI

	K	Cl		K : Cl
KCl →	$\frac{52\%}{52}$	$\frac{48\%}{52}$	⇒	1 : 0.923

	K	I		K : I
KI →	$\frac{23.6}{23.6}$	$\frac{76.4\%}{23.6}$	⇒	1 : 3.237

Cl : I

0.923 : 3.237

1 : 3.5

2 : 7

$ICl = Cl : I \Rightarrow \frac{21.8}{21.8} : \frac{78.2}{21.8} = 1 : 3.5 =$ **Cl : I = 2 : 7**

: What mass of 95% pure $CaCO_3$ will be required to neutralise 50 mL of 0.5 M HCl solution according to the following reaction?

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + 2H_2O(l)$

[Calculate upto second place of decimal point]

(A) 1.25g

(B) 1.32g

(C) 3.65g

(D) 9.50g

NEET 2022

What mass of 95% pure $CaCO_3$ will be required to neutralise 50 mL of 0.5 M HCl solution according to the following reaction?

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + 2H_2O(l)$

[Calculate upto second place of decimal point]

(A) 1.25g

(B) 1.32g

(C) 3.65g

(D) 9.50g

Ans: B

NEET 2022

Qsd-1

In one molal solution that contains 0.5 mole of a solute, there is

(A) 500 mL of solvent

(B) 500 g of solvent

(C) 100 mL of solvent

(D) 1000 g of solvent

NEET 2022

In one molal solution that contains 0.5 mole of a solute, there is

(A) 500 mL of solvent

(B) 500 g of solvent

(C) 100 mL of solvent

(D) 1000 g of solvent

Ans: B

NEET 2022

Qsd-2

An organic compound contains 78% (by wt.) carbon and remaining percentage of hydrogen. The right option for the empirical formula of this compound is: [Atomic wt. Of C is 12, H is 1]

(A) CH_3

(B) CH_4

(C) CH

(D) CH_2

NEET 2021

An organic compound contains 78% (by wt.) carbon and remaining percentage of hydrogen. The right option for the empirical formula of this compound is: [Atomic wt. Of C is 12, H is 1]

(A) CH_3

(B) CH_4

(C) CH

(D) CH_2

Ans: A

NEET 2021

Qsd-3 6.02×10^{20} molecules of urea are present in 100 mL, of its solution. The concentration of solution is

(A) 0.02 M

(B) 0.01 M

(C) 0.001 M

(D) 0.1 M

NEET 2020

6.02×10^{20} molecules of urea are present in 100 mL, of its solution. The concentration of solution is

(A) 0.02 M

(B) 0.01 M

(C) 0.001 M

(D) 0.1 M

Ans: B

NEET 2020

How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0 M HNO_3? The concentrated acid is 70% HNO_3.

(A) 45.0 g Conc. HNO_3

(B) 90.0 g Conc. HNO_3

(C) 70.0 g Conc. HNO_3

(D) 54.0 g Conc. HNO_3

NEET 2019

How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0 M HNO_3? The concentrated acid is 70% HNO_3.

(A) 45.0 g Conc. HNO_3

(B) 90.0 g Conc. HNO_3

(C) 70.0 g Conc. HNO_3

(D) 54.0 g Conc. HNO_3

Ans: A

NEET 2019

1.0g of Magnesium is burnt with 0.56 g of O_2 in closed vessel. Which reactant is left in excess and how much? (At.wt. Mg = 24; O = 16)

(A) Mg, 0.44 g

(B) O_2, 0.28 g

(C) Mg, 0.16 g

(D) O_2, 0.16 g

NEET 2018

1.0g of Magnesium is burnt with 0.56 g of O_2 in closed vessel. Which reactant is left in excess and how much? (At.wt. Mg = 24; O = 16)

(A) Mg, 0.44 g

(B) O_2, 0.28 g

(C) Mg, 0.16 g

(D) O_2, 0.16 g

Ans: C

NEET 2018

Qsd-4

Equal masses of H_2, O_2 and methane have been taken in a container of volume V at temperature 27^0C in identical conditions. The ratio of the volumes of gases $H_2 : O_2$: methane would be:

(A) 16 : 1 : 2

(B) 8 : 1 : 2

(C) 8 : 16 : 1

(D) 16 : 8 : 1

NEET 2018

Equal masses of H_2, O_2 and methane have been taken in a container of volume V at temperature 27^0C in identical conditions. The ratio of the volumes of gases $H_2 : O_2$: methane would be:

(A) 16 : 1 : 2

(B) 8 : 1 : 2

(C) 8 : 16 : 1

(D) 16 : 8 : 1

Ans: A

NEET 2018

In the Kjeldahl's method for estimation of Nitrogen present in a soil sample, Ammonia evolved from 0.75 g of sample neutralized 10 ml of 1M H_2SO_4 . The percentage of Nitrogen in the soil is

(A) 35.33

(B) 43.33

(C) 37.33

(D) 45.33

NEET 2019

In the Kjeldahl's method for estimation of Nitrogen present in a soil sample, Ammonia evolved from 0.75 g of sample neutralized 10 ml of 1M H_2SO_4 . The percentage of Nitrogen in the soil is

(A) 35.33

(B) 43.33

(C) 37.33

(D) 45.33

Ans: C

NEET 2020

When 22.4 litres of $H_{2(g)}$ is mixed with 11.2 litres of $Cl_{2(g)}$, at S.T.P., the moles of HCl(g) formed is equal to

(A) 0.5 mole of HCl(g)

(B) 1.5 mole of HCl(g)

(C) 1 mole of HCl(g)

(D) 2 mole of HCl(g)

NEET 2020

When 22.4 litres of $H_{2(g)}$ is mixed with 11.2 litres of $Cl_{2(g)}$, at S.T.P., the moles of HCl(g) formed is equal to

(A) 0.5 mole of HCl(g)

(B) 1.5 mole of HCl(g)

(C) 1 mole of HCl(g)

(D) 2 mole of HCl(g)

Ans: A

NEET 2020

A mixture of gases contains H_2 and O_2 gases in the ratio of 1:4 (w/w). What is the molar ratio of the two gases in the mixture?

(A) 2 : 1

(B) 1: 4

(C) 4: 1

(D) 16: 1

NEET 2017

A mixture of gases contains H_2 and O_2 gases in the ratio of 1:4 (w/w). What is the molar ratio of the two gases in the mixture?

(A) 2 : 1

(B) 1: 4

(C) 4: 1

(D) 16: 1

Ans: C

NEET 2017

Suppose the elements X and Y combine to form two compounds XY_2 and X_3Y_2. When 0.1 mole of XY_2 weighs 10 g and 0.05 mole of X_3Y_2 weighs 9g, the atomic weights of X and Y are

(A) 60, 40

(B) 20, 30

(C) 30, 20

(D) 40, 30

NEET 2017

Suppose the elements X and Y combine to form two compounds XY_2 and X_3Y_2. When 0.1 mole of XY_2 weighs 10 g and 0.05 mole of X_3Y_2 weighs 9g, the atomic weights of X and Y are

(A) 60, 40

(B) 20, 30

(C) 30, 20

(D) 40, 30

Ans: C

NEET 2017

A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with conc. H_2SO_4. The evolved gaseous mixture is passed through KOH pellets. Weight (in g) of the remaining product at STP will be

(A) 2.8

(B) 3.0

(C) 1.4

(D) 4.4

NEET 2019

A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with conc. H_2SO_4. The evolved gaseous mixture is passed through KOH pellets. Weight (in g) of the remaining product at STP will be

(A) 2.8

(B) 3.0

(C) 1.4

(D) 4.4

Ans: A

NEET 2019

In which case is number of molecules of water maximum?

(A) 0.00224 L of water vapours at 1 atm and 273 K

(B) 0.18 g of water

(C) 18 mL of water

(D) 10^{-3} mol of water

NEET 2018

In which case is number of molecules of water maximum?

(A) 0.00224 L of water vapours at 1 atm and 273 K

(B) 0.18 g of water

(C) 18 mL of water

(D) 10^{-3} mol of water

Ans: D

NEET 2018

Which of the following is dependent on temperature?

(A) Mole fraction

(B) Weight percentage

(C) Molality

(D) Molarity

NEET 2017

Which of the following is dependent on temperature?

(A) Mole fraction

(B) Weight percentage

(C) Molality

(D) Molarity

Ans: D

NEET 2017

The number of moles of hydrogen molecules required to produce 20 moles of ammonia through Haber's process is :

(A) 20

(B) 30

(C) 40

(D) 10

NEET 2017

The number of moles of hydrogen molecules required to produce 20 moles of ammonia through Haber's process is :

(A) 20

(B) 30

(C) 40

(D) 10

Ans: B

NEET 2017

THANK YOU !!

MANTHAN NEET 2025

Manthan-2.0 plus → Free → Manthan-1.0
↳ 3 to 5 Lecture → 2.30 hr

CHEMISTRY

→ Liqiud solution

Jan-Last
feb → 1 week

(Man-2.0 plus + NYTS) →

Lecture-01



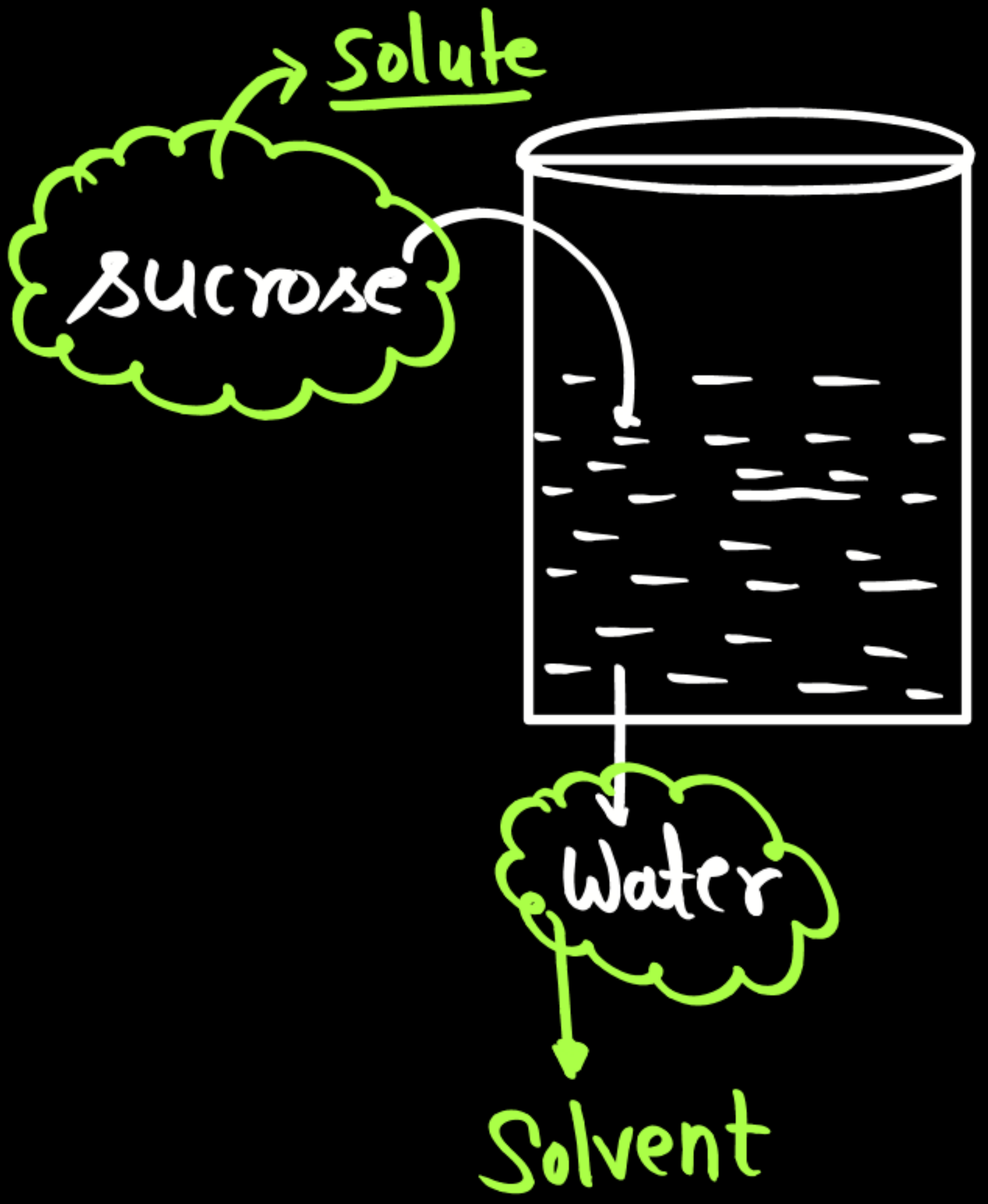
Sarvesh Sir

Lecture → Recorded → 2·3 → 3hr → 1·5 → 1 to 1·5

Today's Goal -

Vapour pressure

SOLUTION



→ Solution → Matter-1 + Matter-2

liquid + liquid

It is a Homogeneous mixture of more than one different matter

large scale → Solvent

Small scale → Solute

Ex → 10ml Alcohol + 500ml H_2O

Solvent = ? → H_2O

Solute ⇒ ? → Alcohol

TYPE OF SOLUTION

1.1 Types of Solutions

Solutions are **homogeneous** mixtures of two or more than two components. By homogenous mixture we mean that its composition and properties are uniform throughout the mixture. Generally, the component that is present in the largest quantity is known as **solvent**. Solvent determines the physical state in which solution exists. One or more components present in the solution other than solvent are called **solutes.** In this Unit we shall consider only **binary solutions** (i.e.,

→ Solvent + Solute (one)
→ 2 Component wale sol^n
= binary solution

CSD

uniformally distribution

Solution → Min. 2-Component Homogeneous mixture

Solvent → large scale

Solute → small scale

binary Solution → 2-Component (Solvent + solute)

→ Solvent Ke nature (physical State) pr solution Ka nam Rakhte hai

Ex → H_2O + glucose, $H_2O + O_2$, H_2O + Alcohol → liquid solⁿ

→ 9 type solution possible, but gas-gas solⁿ is called gaseous mixture, so → mainly 8 type

Type of solution

physical state → Gas, liquid, solid

③ **Solvent → liquid** + Solute →
- liquid
- gas
- solid

↓ liquid solution

③ **Solvent → Solid** + Solute →
- liquid
- Gas
- solid

Solid solution

Table 1.1: Types of Solutions

→** Imp.

Type of Solution	Solute	Solvent	Common Examples
Gaseous Solutions	Gas	Gas	Mixture of oxygen and nitrogen gases
	Liquid	Gas	Chloroform mixed with nitrogen gas
	Solid	Gas	Camphor in nitrogen gas
Liquid Solutions	Gas	Liquid	Oxygen dissolved in water
	Liquid	Liquid	Ethanol dissolved in water
	Solid	Liquid	Glucose dissolved in water
Solid Solutions	Gas	Solid	Solution of hydrogen in palladium
	Liquid	Solid	Amalgam of mercury with sodium
	Solid	Solid	Copper dissolved in gold

3
3
3
9-type

Note → gas-gas solution ko gaseous mixture bolte hai

mainly 9 type ke solⁿ hote hai



Q. Chlorine dissolved in water, is a example of

↳ liquid → liquid solution

solvent

(A) Gaseous Solution

(B) Liquid Solution ✓

(C) Solid Solution

(D) None

Q. Sodium chloride dissolved in water, is a example of

solvent → liquid sol^n

(A) Gaseous Solution

(B) Liquid Solution

(C) Solid Solution

(D) None

Q. Select the example of liquid solution

A. Ethyl alcohol dissolved in water

B. Gglucose dissolved in water

C. Common salt (NaCl) dissolved in water

D. All

Exercises

1.1 Define the term solution. How many types of solutions are formed? Write briefly about each type with an example.

1.2 Give an example of a solid solution in which the solute is a gas.

Solid solution → solvent-solid ⇒ Pt | H_2

solute → gas ⇒ Pd | H_2

⇒

Liquid solution

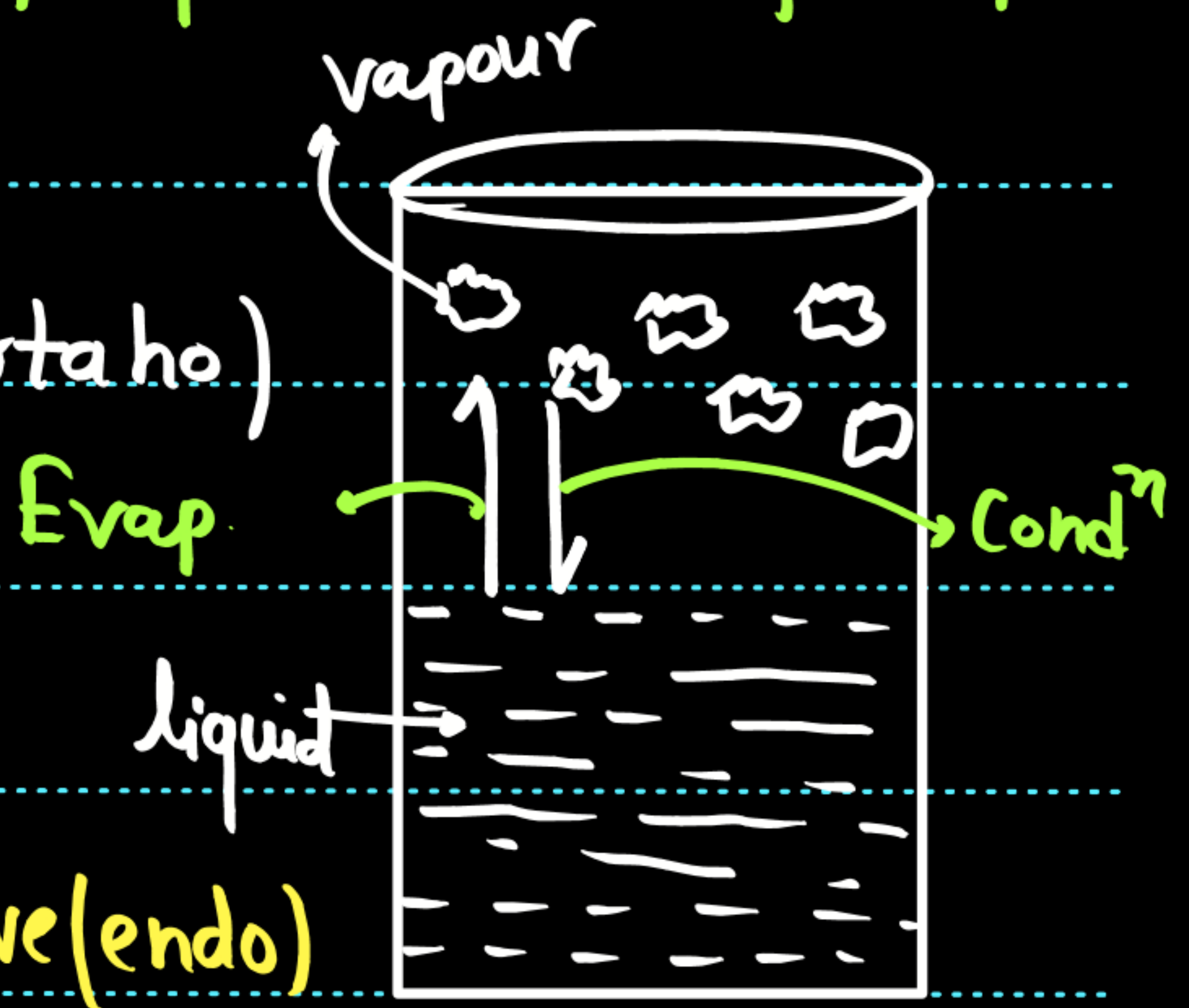
Solvent = liquid + solute

- gas = gas-liq solⁿ ⇒ Henry's law
- liquid = liq-liq solⁿ = Raoult's law
- solid = solid-liq solⁿ = Colligative propʳ

Condition — total pressure exert by vapour of liquid on the surface of liquid at Equilibrium.

1) Close Container

2) liquid ⇒ volatile nature (vapour form krta ho)



$$\text{liquid}(H_2O) \rightleftharpoons \text{vapour}(H_2O)$$

$\Delta H_{vap} = +ve$ (endo)

$$K_p = \frac{(\text{Pressure of product})^1}{(\text{pressure of Reactant})^1} \Rightarrow K_p = \frac{P_{vap}}{1}$$

$P_{vap} = K_p$ ↓   Eq. Constant

vapour pressure of pure liquid

- Evaporation = liquid turns into gas
- Condensation = liquid vapour convert into liquid
- Total pressure exerted by the vapour of liquid on the surface of liquid in close container at equilibrium (evaporation $\rightleftharpoons$ condensation)

Q $H_2O(l) \rightleftharpoons H_2O(vap.)$, Kq = 7.2×10^2 mm calculate the vapour pressure of liquid at equilibrium

(A) $P = 7.2 \times 10^2$ mm ✓

(B) $P = 1$ mm

(C) $P = 1$ atm

(D) $P = 7.2 \times 10^{-2}$ mm

$P_{vap} = K_{eq} = 7.2 \times 10^2$

CSD → Vapour pressure → pressure exerted by vap of liq. on the surface of liq. in Close container at Eq. (evap $\rightleftharpoons$ Cond^n)

Condition → Close container, volatile liquid nature

→ $H_2O(l) \rightleftharpoons vap.(H_2O)$, $\Delta H_{vap} = +ve$, $P_{vap} = K_{eq}$

*** → Vap. pressure of pure liq. Only depend upon temperature and nature of liquid, Reason ⇒ $P_{vap} = K_{eq}$ (only depend upon temp.)

→ Amount → ×, surface Aera → ×, size, shape → ×

→ Vap. pressure (P_{vap}) $\propto$ temperature

$$\ln \frac{P_2}{P_1} = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$ → NEET nahi aya hai

<u>Where</u> T_1 K temp → Vap pressure → P_1

T_2 K → P_2

ΔH_{vap} = Enthalpy of vapourization

Q

Vapour pressure of water at 300 K temperature is P_1 atm and 400 K temperature is P2 atm, then calculate $\ln\frac{P_1}{P_2}$ value.

$H_2O(l)$ ======= $H_2O(vap)$, ΔH_{vap} = 8.314 Joule

(A) $\frac{1}{12}$

(B) $\frac{1}{1200}$

(C) 1200

(D) $\frac{1}{120}$

$$\ln\frac{P_2}{P_1} = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\ln\frac{P_2}{P_1} = \frac{8.314}{8.314}\left(\frac{1}{300} - \frac{1}{400}\right)$$

$$\ln\frac{P_2}{P_1} = \frac{100}{400 \times 300} = \frac{1}{1200}$$

$$\ln\frac{P_1}{P_2} = 1200$$

Q

The vapour pressure of water of 290 K in a closed container is 750 torr. If the volume of the container is tripled , then its vapour pressure at 290 K will be

(A) 2250 torr

(B) 750 torr

(C) 250 torr

(D) 290 torr

$P_{vap} = K_{eq}$

Vapour pressure of pure liquid (A) at 300 K is X atm. If the temperature of container increase to 400 K, then the vapour pressure of pure liquid (A) will be at 400 K

(A) P > x atm

(B) P < x atm

(C) P = x atm

(D) $P = \frac{x}{2}$ atm

$P_{vap} \propto$ temp

MANTHAN NEET 2025

CHEMISTRY

Liqiud solution

Lecture-02



Sarvesh Sir

Today's Goal -

Vapour pressure

Qsd-1 O_2 gas absorbed in liquid water at 320 K temperature, above solution belong to

a) Gas solution

b) liquid solution ✓

c) Solid solution

d) All

liquid solution

Qsd-2 10ml liquid Benzene have vapour pressure 350mm of Hg. If volume of liquid Benzene increases 10 times of initial volume, than vap. pressure increases

a) 10 times

b) 2 times

c) Remains same

d) 20 times

Vap. pressure ∝ temp.

$\frac{?}{2}$

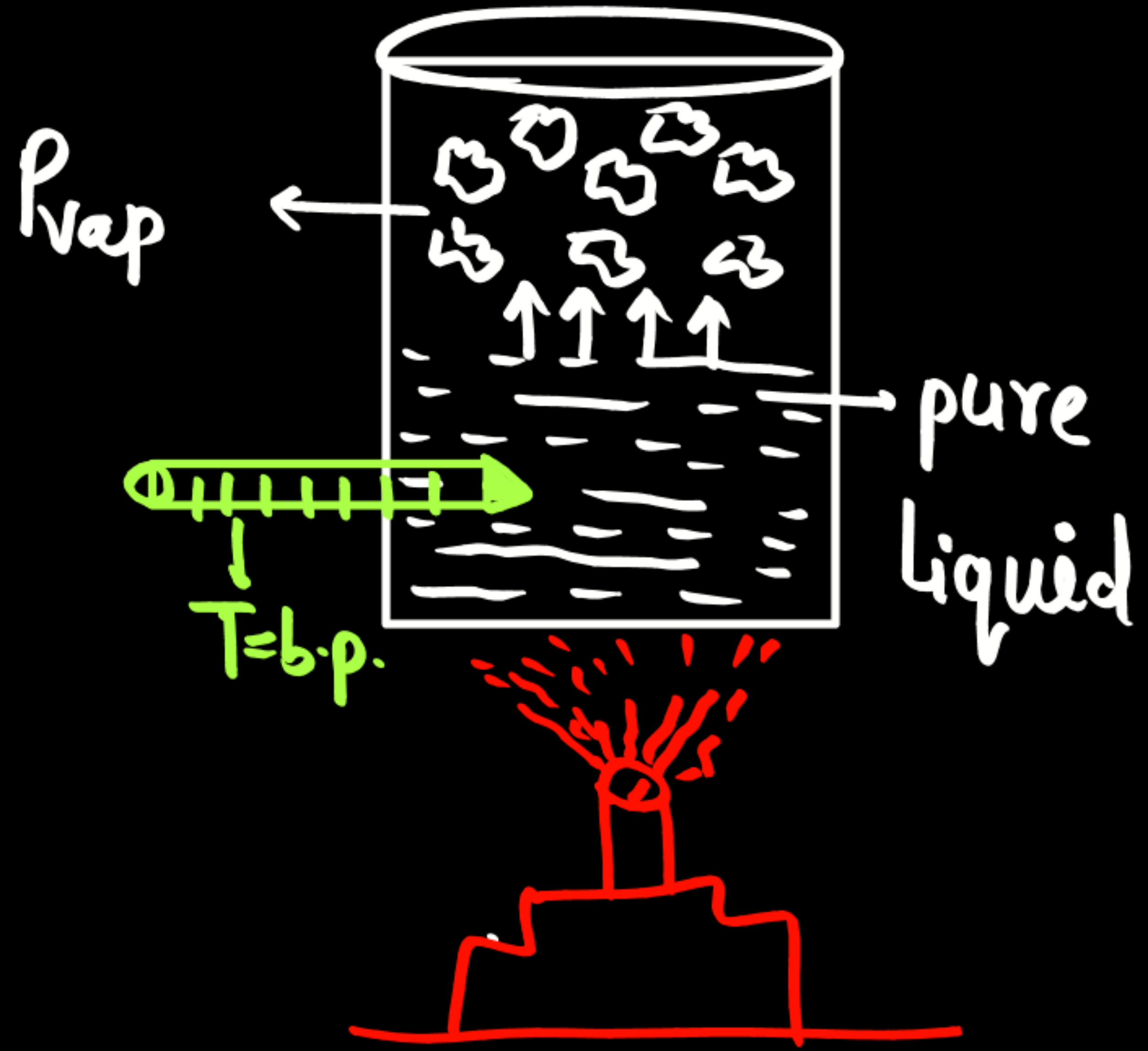
Relation between vapour Pressure of liquid and boiling point

B.P. $P_{vap} = P_{atm}$



$1\,atm = P_{atm}$

At that temperature, the vap pressure of liquid is equal to atomspheric pressure (P_{atm}).



→ **B.P $\propto$ P_{atm}**

Water → $P_{atm} = 1\,atm$ → b.p. = 100°c

$P_{atm} = \frac{1}{2}\,atm$ → b.p. = 50°c

$P_{atm} = 2\,atm$ → b.p. = 200°c

CSP B.P. → $T = b.p \rightarrow P_{vap} = P_{atm}$

→ $T_{b.p.} \propto P_{atm}$

→ water → $P_{atm} = 1atm \rightarrow T_{b.p} = 100^\circ C$ or $373K$

→ B.P. ∝ Attraction force b/w two molecules of liquid

A.f. → Ion-Ion > H-bond > dipole-dipole > nonpolar-nonpolar

→ Vap. pressure ∝ temp.

→ vap. pressure $\propto \frac{1}{B.P.}$

↓

(2-liquid Ke compare me)

→ Vap. pressure $\propto \frac{1}{\text{Attract}^n \text{ Force b/w molecules}}$

Q Boiling point of liquid A & B are 300 K and 400 K respectively, select correct statements (if- P_A & P_B are vapour pressure of liquid A & B) at 280K temp.

(A) $P_A > P_B$

(B) $P_A < P_B$

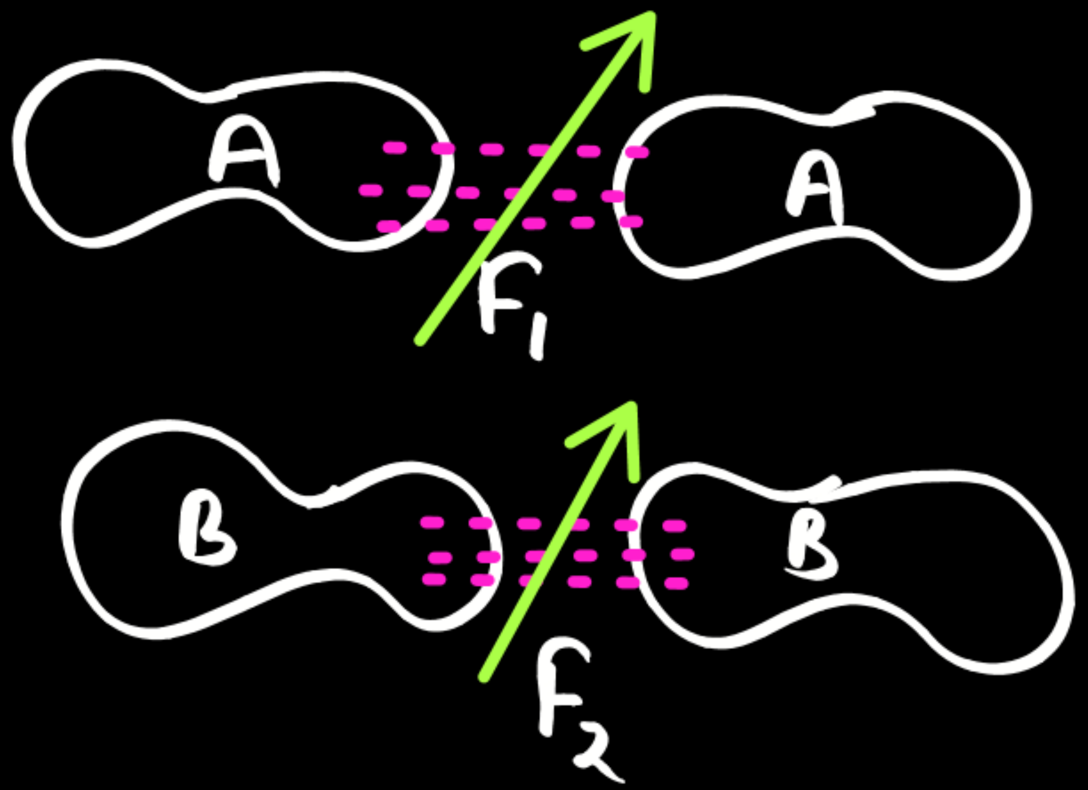
(C) $P_A = P_B$

(D) $P_A > 2P_B$

$P_{vap} \propto \frac{1}{B.P.}$

Effect of nature of liquid

B.P. $\propto$ Attraction force



$\rightarrow F_1 > F_2$

$$P_{vap} \propto \frac{\quad}{\text{Attraction force b/w molecule}}$$

Ex → H_2O → b.P. → T_1 K (H-bonding)

C_6H_6 → b.p. → T_2 K (nonpolar)

Select Correct relation.

a) $T_1 = T_2$ ~~b)~~ $T_1 > T_2$ (c) $T_1 < T_2$

d) Can, not say

Q → liq-A → b.p. = 400K

liq-B → b.p. = 500K

Vap. pressure order at 380K

a) $P_A > P_B$

b) $P_A < P_B$

c) $P_A = P_B$

d) Can not say

$P_{vap} \propto \frac{1}{B.P.}$

6. Vapour pressure of liquid CH_4 and SO_2 at TK temperature is P_1 & P_2 atm respectively. Select the correct option

(A) $P_1 > P_1$

(B) $P_1 < P_2$

(C) $P_1 = P_2$

(D) $P_1 = \frac{2P_2}{3}$

$\mu = 0 \rightarrow CH_4 \rightarrow$ np

$\mu \neq 0$ $SO_2 \rightarrow$ polar

$P_{vap} \propto \frac{1}{A \cdot F}$

H-bonding > dipole-dipole

→ H-(F, O, N) → H-bonding

→ $\mu = 0 \rightarrow$ nonpolar

→ $\mu \neq 0 \rightarrow$ polar

BINARY SOLUTION

↓

2-Component hote hai

→ solute
+
→ solvent

Case-I → Solute + Solvent] → both liq. are Volatile nature (vapour formation)

Case→2 →] Solute → nonvolatile (vapour nahi form krta hai → $P_{vap} = 0$)
+
Solvent → Volatile

Vapour Pressure of solution (Raoult's law)

Case-1 ⇒ both liquid (solute & solvent) form vapour

$$P_T = P_A + P_B$$

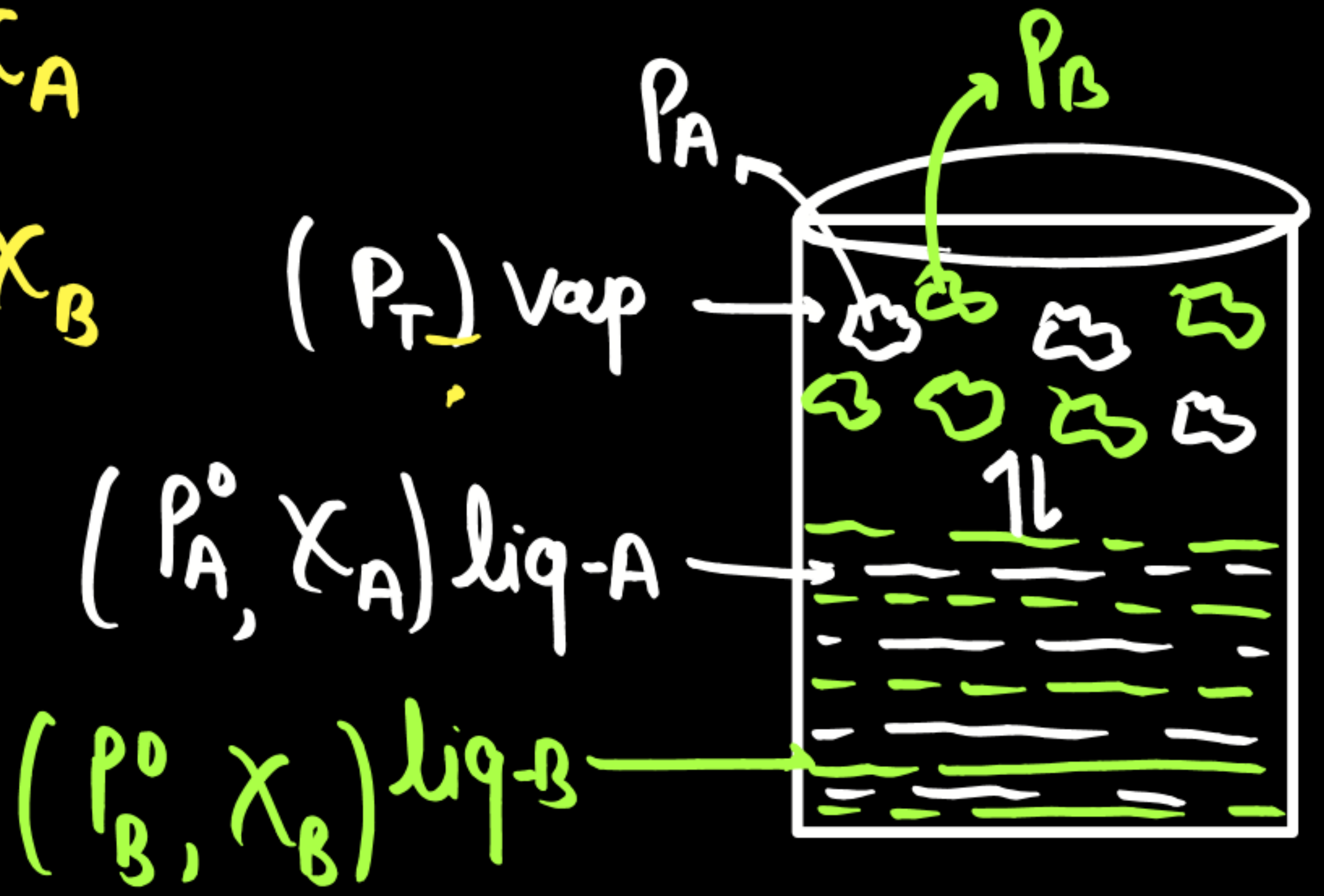
$$P_A = P_A^0 X_A$$

$$P_B = P_B^0 X_B$$

$$\boxed{P_T = P_A^0 X_A + P_B^0 X_B}$$

$$X_A + X_B = 1$$

$$X_A = (1 - X_B)$$



$$P_T = P_A^0 (1 - X_B) + P_B^0 X_B$$

$$= P_A^0 - P_A^0 X_B + P_B^0 X_B$$

*****

$$P_T = (P_B^0 - P_A^0) X_B + P_A^0$$

X_B → variable

→ P_T Vs X_A ⇒ $P_T = P_A^0 X_A + P_B^0 X_B$

$$= P_A^0 X_A + P_B^0 (1 - X_A)$$

$$= P_A^0 X_A + P_B^0 - P_B^0 X_A$$

$$P_T = (P_A^0 - P_B^0) X_A + P_B^0$$

ABB

BAA

$$P_T = (P_A^0 - P_B^0) X_A + P_B^0$$

$$P_T = (P_B^0 - P_A^0) X_B + P_A^0$$

Q → P_T & X_A

$$P_T = (P_A^0 - P_B^0)X_A + P_B^0$$

Q → P_T & X_B

$$P_T = (P_B^0 - P_A^0)X_B + P_A^0$$

Q → Select Correct R.L. Equation

a) $P_T = (P_B^0 - P_A^0)X_A + P_B^0$ ✗

b) $P_T = (P_A^0 - P_B^0)X_B + P_A^0$ ✗

c) $P_T = (P_B^0 - P_A^0)X_B + P_A^0$ ✓

d) All

A B (B) $\quad$ $X_B \rightarrow$ B A (A) $\quad$ B A (A)

Q → total pressure of solⁿ of liq-A & liq-B is

$P_T = 120 X_A + 240$; Calculate value of P_A° & P_B°

Solⁿ

$(P_A^\circ - P_B^\circ) X_A + P_B^\circ$

$P_B^\circ = 240$ mm

$P_A^\circ - P_B^\circ = 120$

$P_A^\circ = 120 + P_B^\circ = 120 + 240$

$P_A^\circ = 360$ mm

$P_A^\circ = 100$

Q → $P_T = 40 X_B + 60$ (P_A°)

Q = $P_T = -40 X_B + 60$ (P_A°)

$P_B^\circ = -40 + 60 = 20$

$\phi \rightarrow \quad P_T = 70\,X_A + 90$

($70 \rightarrow P_A^0 = 160$; $90 \rightarrow P_B^0$)

Calculate $\rightarrow \dfrac{P_A^0}{P_B^0} = ?$

$$\frac{P_A^0}{P_B^0} = \frac{160}{90} = \frac{16}{9}$$

CSD → Case-1 ⇒ both liquid (solute & solvent) = volatile nature

Raoult's law → $P_T = P_A + P_B$ = $P_A^0 X_A + P_B^0 X_B$

where → X_A, X_B = mole fract^n of liq-A & liq-B in liquid solution

→ P_A^0, P_B^0 ⇒ Vap. pressure of pure liq-A & liq-B

Note → P_A^0, P_B^0 = Const (not depend upon amount ⇒ Reason ⇒ $P_{vap}^0 = K_{eq}$)

→ $P_A \propto X_A$, $P_B \propto X_B$ (Partial vap. pressure of liq-A & liq-B in solution)

→ $P_T = (P_A^0 - P_B^0) X_A + P_B^0$ ⇒

→ $P_T = (P_B^0 - P_A^0) X_B + P_A^0$

→ suppose → $P_T = a X_A + b$ → $P_B^\circ = b$, $P_A^\circ = a + b$ (with sign)


THANK
YOU

MANTHAN NEET 2025

CHEMISTRY

Liqiud solution

Lecture-03



Sarvesh Sir

Test Ka syllabus

1) Solution
2) type of solⁿ
3) Vapour pressure
4) Raoult's law (1st Case)

Test class → ***

Copy → Test class

→ NYTS - Test series

25 test

→ 3 to 4 bar syllabus Revision

→ At HOME

Today's Goal -

Vapour pressure
Raoult's law

Qsd-1 Select Correct Equation of Raoult's law

a) $P_T = P_A^0 X_A$

b) ✗ $P_T = (P_B^0 - P_A^0) X_A + P_B^0$

c) $P_T = (P_A^0 - P_B^0) X_A + P_B^0$

✗ d) $P_T = (P_B^0 - P_A^0) X_B + P_B^0$

ABB

$(P_A^0 - P_B^0) X_A + P_B^0$

A BB

Qsd-2 total vapour pressure of solution of liq-A and liq-B is, $P_T = 80X_A + 120$. Calculate vap. pressure of P_A

a) 200 mm //

b) 80 mm

c) 120 mm

d) 60 mm

$P_A^0 - P_B^0$

$$P_T = (P_A^0 - P_B^0)X_A + P_B^0$$

$$P_B^0 = 120$$

$$P_A^0 - P_B^0 = 80$$

$$P_A^0 = 80 + P_B^0 = 80 + 120 = 200$$

$$P_A^0 = 80 + 120 = 200$$

$$\frac{?}{2}$$

Vapour Pressure of solution (Raoult's law)

<u>Case-1</u> → both liquid (solute + solvent) → Volatile nature

CSD Case-1 ⇒ both liquids are volatile nature (Raoult's law)

Condition (A) $\overset{F_A}{—}$ (A) = (B) $\overset{F_B}{—}$ (B) = (A) $\overset{F_{AB}}{—}$ (B) ⇒ $F_A \approx F_B \approx F_{AB}$

suppose

2) liq-A & liq-B = NO Rxn

3) {P_T} → P_A^0 to P_B^0 → $P_A^0 \leq P_T \leq P_B^0$ → $(P_A^0 < P_B^0)$, $P_A^0 \geq P_T \geq P_B^0$ → $(P_A^0 > P_B^0)$

4) Mole of liq-A ≈ mole of liq-B → $\boxed{P_T = \dfrac{P_A^0 + P_B^0}{2}}$ → $X_A = \frac{1}{2}$, $X_B = \frac{1}{2}$

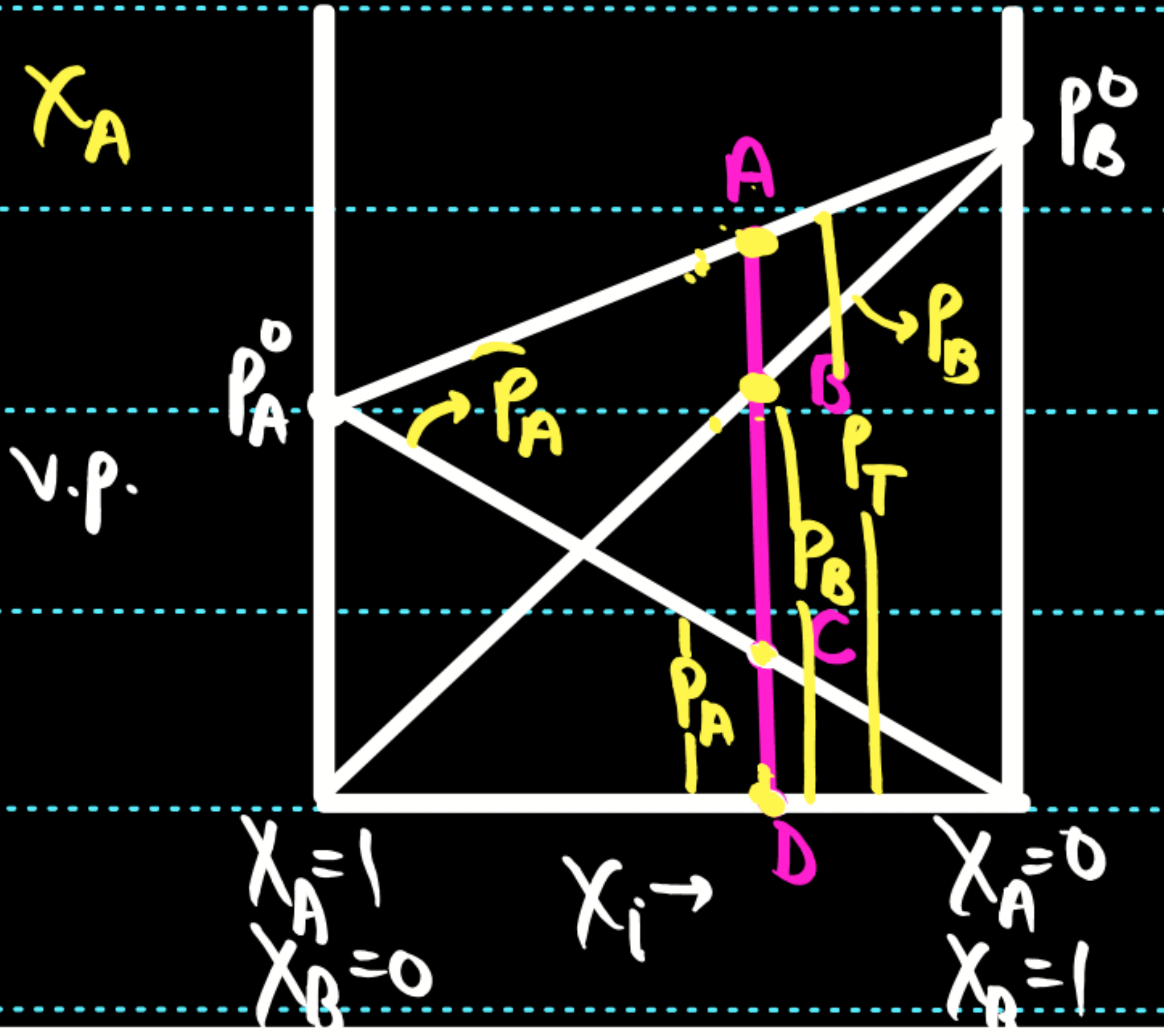
5) Composition of mixture of binary solution, when vap. pressure is minimum → $(P_T)_{min} \approx P_A^0$ (Chhoda wala v.p. Ke equal) → $X_A \approx 1$, $X_B \approx 0$

CSD 6) Maximum vap. pressure of soln. $(P_T)_{max} \approx P_B^0$ (Jo vap. pressure of pure liq. bada hoga, uske equal) → $X_B \approx 1, X_A \approx 0$

7) $P_T = P_A + P_B$

$AD = DC + DB$

$P_A = P_A^0 X_A$



$$P_T = P_A^0 X_A + P_B^0 X_B = P_A + P_B$$

Suppose → $P_A^0 < P_B^0$

$$P_A = P_A^0 X_A \longrightarrow P_A \text{ Vs } X_A$$

$$P_B = P_B^0 X_B$$

$$\underset{y}{P_A} = \underset{m}{P_A^0}\,\underset{x}{X_A}$$

$X_A = 0 \rightarrow P_A = 0$

$X_A = 1 \rightarrow P_A = P_A^0$

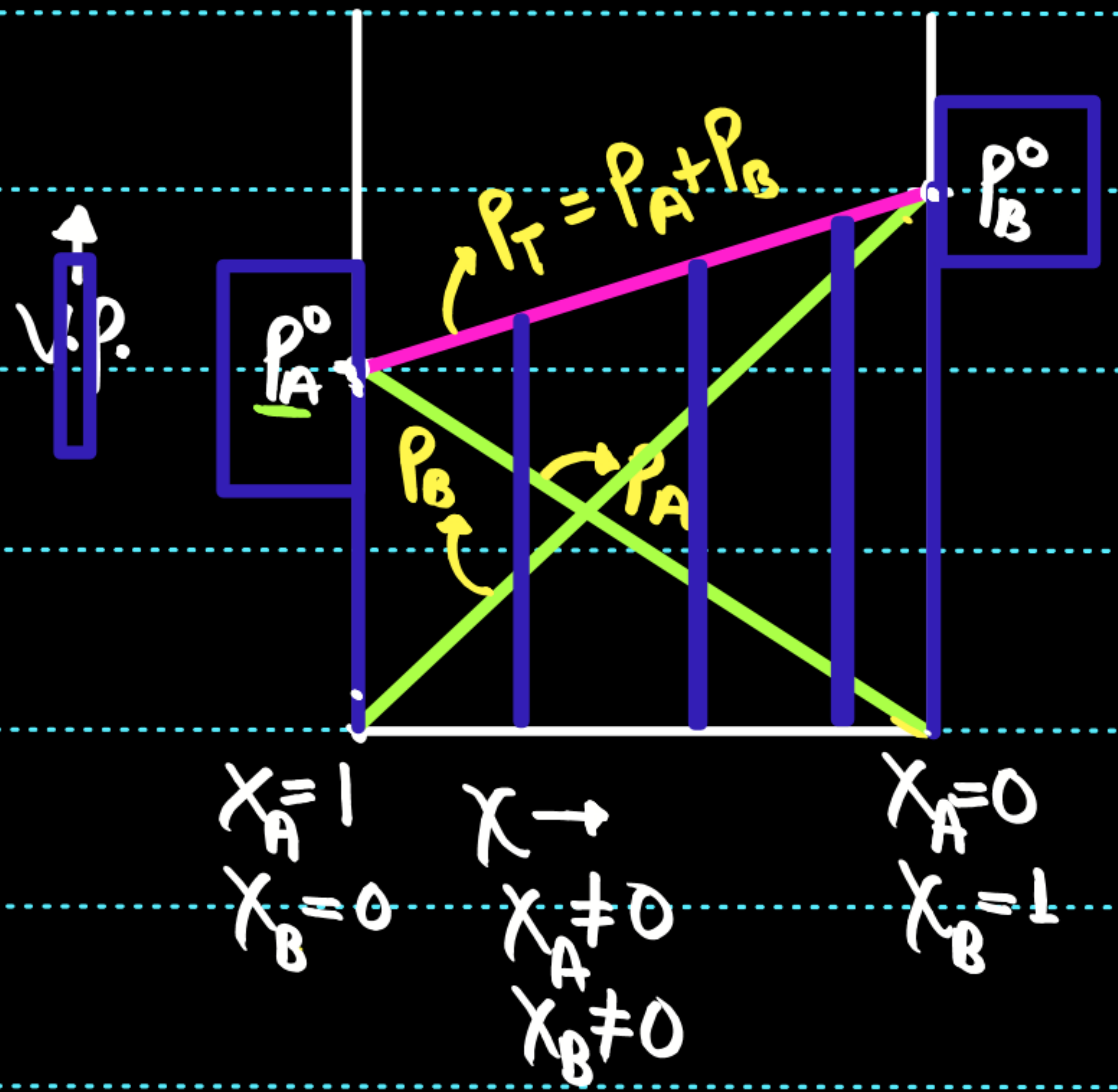
$$P_B = P_B^0 X_B$$

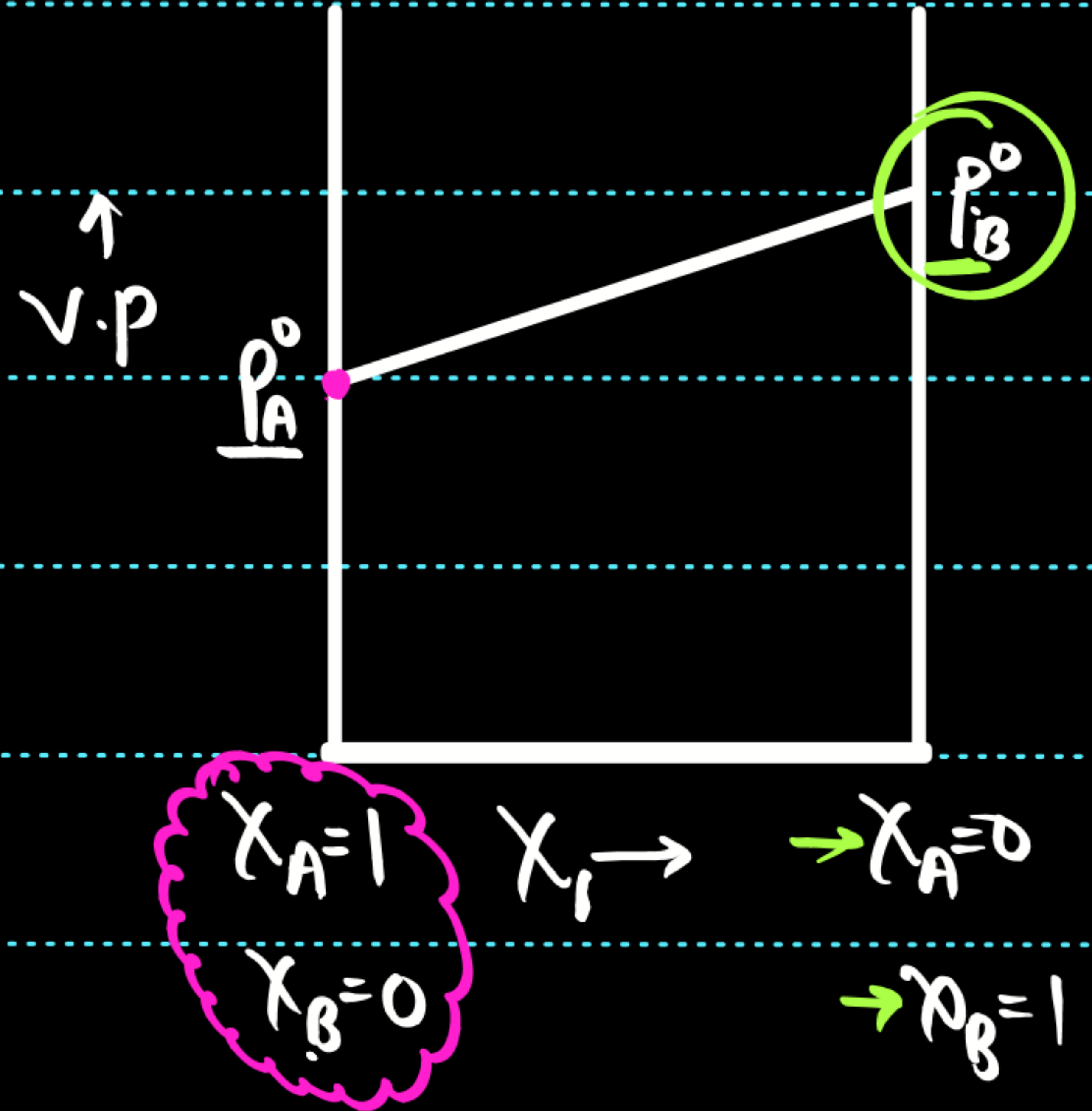
$X_B = 0 \rightarrow P_B = 0$, $X_B \rightarrow 1$, $P_B = P_B^0$

$P_A = P_A^0 X_A$

$P_B = P_B^0 X_B$

$P_T = P_A^0 X_A + P_B^0 X_B$





Q → $P_A^0 = 560$, $P_B^0 = 820$ mm, the total vap. pressure of sol^n is approx 560 mm of Hg., select Composition of sol^n.

$X_A=1$
$X_B=0$

a) $X_A=1, X_B=0$ ✓

b) $X_A=0, X_B=1$

c) $X_A=\frac{1}{2}, X_B=\frac{1}{2}$

d) NONE

$n_A = 10$, $n_B = 10$

$X_A = \frac{10}{20}$, $X_B = \frac{10}{20}$

$P_T = P_A^0 \times \frac{1}{2} + P_B^0 \times \frac{1}{2}$

$= \frac{P_A^0 + P_B^0}{2}$

Q → 2.2 mole of liq-A mix with 2.2 mole of liq-B and form binary solⁿ. ($P_A^0 = 240$ & $P_B^0 = 260$ mm)

Calculate total pressure of solⁿ

a) 420 b) 375 (c) 250

d) NONE

$\frac{240+260}{2} = 250$

Q → total vap pressure of solution is approx its maximum value, the mole fraction of liq-A in solution is approx

$P_A^\circ = 1200\,mm$ & $P_B^\circ = 900\,mm$)

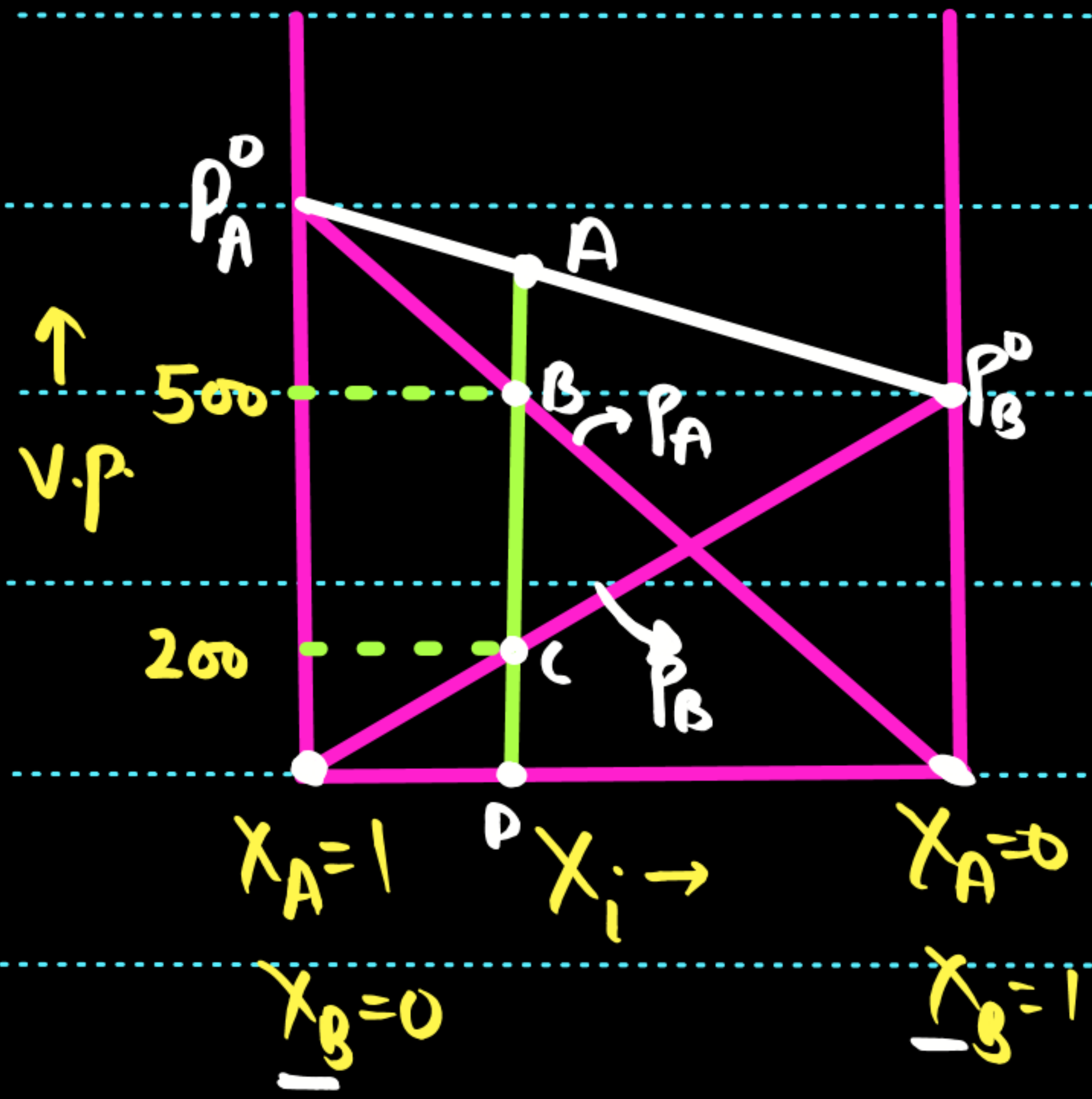
$(P_T)_{max} \rightarrow P_A^\circ = 1200$
↓
$X_A = 1$

a) $X_A \rightarrow 1$

b) $X_A \rightarrow 0$

c) $X_A = \frac{1}{2}$

d) $X_A = 0.8$



Q→1 → vap. pressure of liq-A → $P_A = 500$

Q-2 → vap. pressure of liq-B → $P_B = 200$

Q-3 → total vap. pressure of sol^n

$$P_T = P_A + P_B = 500 + 200 = 700$$

Q31. A solution containing components A and B follows Raoult's law, when

[CBSE AIPMT 2002]

(a) A-B attraction force is greater than A-A and B-B

(b) A-B attraction force is less than A-A and B-B

(c) A-B attraction force remains same as A-A and B-B

(d) Volume of solution is different from sum of volumes of solute and solvent

$F_A = F_B = F_{A-B}$

Q

The vapour pressure of pure liquids A and B are 500 and 800 mm Hg respectively, at 350 K. the possible total vapour pressure of solution at 350 k temperature would be

$500 \leq P_T \leq 800$

(A) $P = 135$

(B) $P = 495$

(C) $P = 365$

(D) $P = 780$

Q29. The vapour pressure of two liquids P and Q are 80 and 60 torr, respectively. The total vapour pressure of solution obtained by mixing 3 moles of P and 2 moles of Q would be [CBSE AIPMT 2005]

(a) 140 torr ✗

(b) 20 torr ✗

(c) 68 torr

(d) 72 torr

$$P_T = P_A^0 X_A + P_B^0 X_B$$

$$80 \times \left(\frac{3}{3+2}\right) + 60\left(\frac{2}{3+2}\right)$$

$$= 80 \times \frac{3}{5} + 60 \times \frac{2}{5}$$

$$48 + 24$$

$$= 72$$

Q13. p_A and p_B are the vapour pressure of pure liquid components A and B, respectively of an ideal binary solution. If $|_A$ represents the mole fraction of component A, the total pressure of the solution will be

[CBSE AIPMT 2012]

(a) $p_A + x_A (p_B - p_A)$

(b) $p_A + x_A (p_A - p_B)$

(c) $p_B + x_A (p_B - p_A)$

(d) $p_B + x_A (p_A - p_B)$

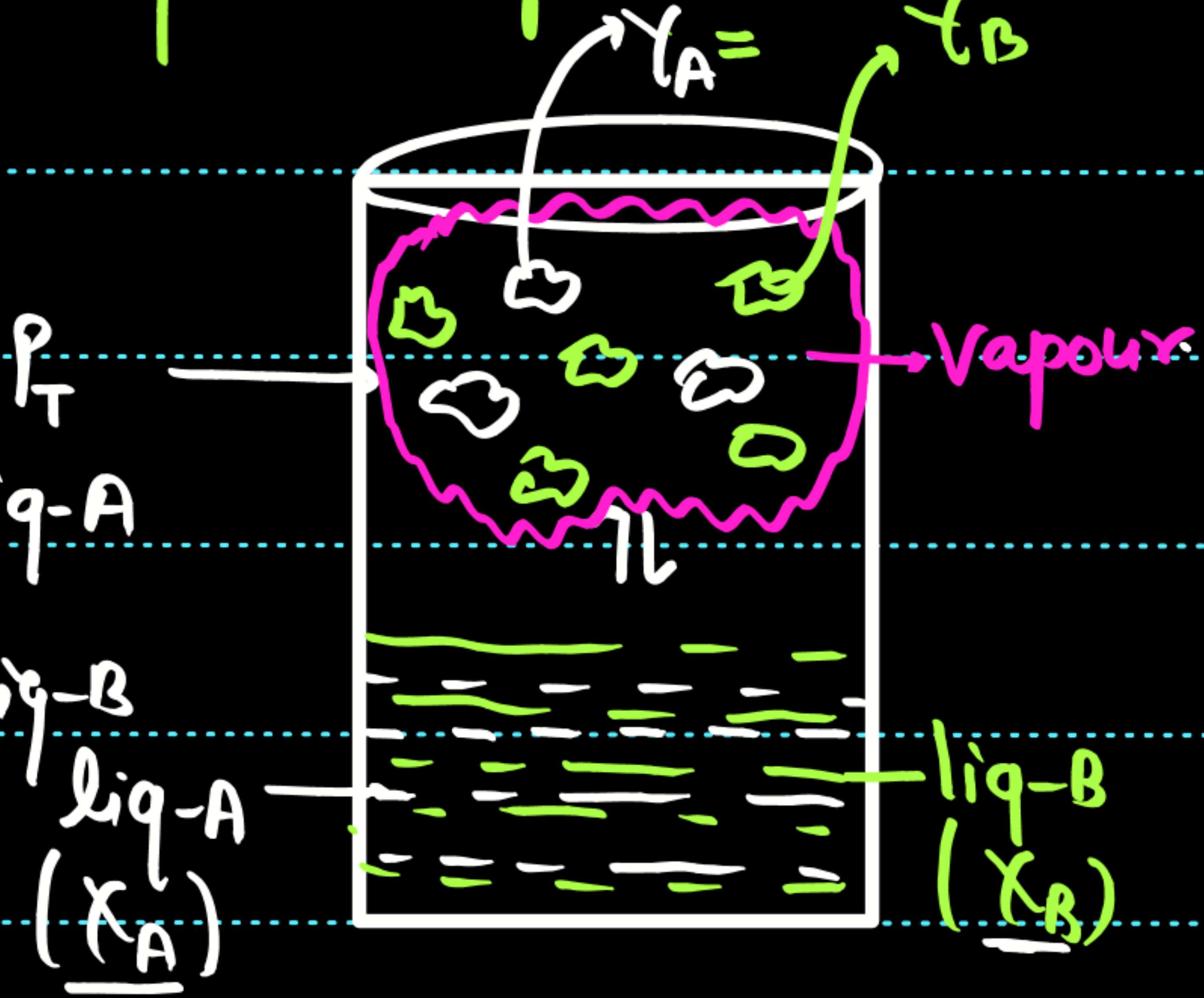
Composition of mole fraction of liq-A & liq-B in Vapour phase

X_A = mole fractⁿ of liq-A in liq. solⁿ

X_B = mole fractⁿ of liq-B in liq. solⁿ

Y_A = mole fractⁿ of vapour phase of liq-A

Y_B = mole fractⁿ of vapour phase of liq-B



$$Y_A = \frac{P_A}{P_T} = \frac{P_A^0 X_A}{P_A^0 X_A + P_B^0 X_B}$$

$$Y_B = \frac{P_B}{P_T} = \frac{P_B^0 X_B}{P_A^0 X_A + P_B^0 X_B}$$

Q → 2 mole of liq-A mix with 3 mole of liq-B and form binary soln. ($P_A^0 = 400$ mm, $P_B^0 = 600$ mm), Calculate mole fraction of liquid-A in vapour phase.

a) $\frac{1}{2}$

b) 0.543

c) 0.732

d) NONE

$$Y_A = \frac{P_A}{P_T}$$

$$P_A = P_A^0 X_A = 400 \times \frac{2}{2+3} = 400 \times \frac{2}{5} = 160$$

$$P_B = P_B^0 X_B = 600 \times \frac{3}{5}$$

$$P_B = 360$$

$$P_T = P_A + P_B = 160 + 360 = 520$$

$$= \frac{160}{520}$$

$$Y_A = 0.307$$

CSD

→ Mole fraction of liq-A in vapour phase $(Y_A) = \dfrac{P_A}{P_T} = \dfrac{P_A^0 X_A}{P_A^0 X_A + P_B^0 X_B}$

→ Mole fraction of liq-B in vapour phase $(Y_B) = \dfrac{P_B}{P_T} = \dfrac{P_B^0 X_B}{P_A^0 X_A + P_B^0 X_B}$

→ $$\frac{Y_A}{Y_B} = \frac{P_A}{P_B} = \frac{P_A^0 X_A}{P_B^0 X_B} = \left(\frac{P_A^0}{P_B^0}\right)\left(\frac{n_A}{n_B}\right) = \left(\frac{P_A^0}{P_B^0}\right)\left(\frac{W_A}{W_B}\right)\left(\frac{M_B}{M_A}\right)$$

***

→ $Y_A + Y_B = 1$

$$\frac{Y_A}{Y_B} = \frac{\text{molality} \times \text{M.wt of solvent}}{1000} \times \left(\frac{P_A^0}{P_B^0}\right)$$

$$X_A = \frac{n_A}{n_T}$$

$$X_B = \frac{n_B}{n_T}$$

$$\frac{X_A}{X_B} = \frac{n_A}{n_B}$$

$$\frac{X_A}{X_B} = \frac{m \times m\cdot wt \text{ of solvent}}{1000}$$

Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 298 K are 200 mm Hg and 415 mm Hg respectively. (i) Calculate the vapour pressure of the solution prepared by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl_2 at 298 K and, (ii) mole fractions of each component in vapour phase.

Example 1.5

Solution

H.W.

Intext Question

1.8 The vapour pressure of pure liquids A and B are 450 and 700 mm Hg respectively, at 350 K. Find out the composition of the liquid mixture if total vapour pressure is 600 mm Hg. Also find the composition of the vapour phase.

H.W.


THANK YOU

MANTHAN NEET 2025

SANKALP NEET VEDANTU

→ Mole Concept → Notes

Csd

→ Liquid Solution → Csd

Telegram channel

→ Manthan-NEET

CHEMISTRY

Liqiud solution

Lecture-04



Sarvesh Sir

Today's Goal -

Vapour pressure
Raoult's law

Q. At 40°C, the vapour pressure in torr of methyl alcohol-ethyl alcohol solution represented by

$$P = 110x + 130$$

where x is the mole fraction of methyl alcohol. What is the composition of liquid when the vapour pressure of the mixture is maxmum ?

(A) Xm = 1, Xe = 0

(B) Xm = 0, Xe = 1

(C) Xm = .5, Xe = .5

(D) XKm = .77, Xe = .23

Qsd-1

$130 \rightarrow P_e^\circ,\ P_m^\circ = 240\ \ x \rightarrow x_m$

$X_m = 1,\ X_e = 0$

$(P_T)_{max} = P_m^\circ$ or P_e°

Qsd-2

Q27. A solution has 1 : 4 mole ratio of pentane to hexane. The vapour pressure of the pure hydrocarbons at 20ºC are 440 mm of Hg for pentane and 120 mm of Hg for hexane. The mole fraction of pentane in the vapour phase would be **[CBSE AIPMT 2005]**

(a) 0.549

(b) 0.200

(c) 0.786

(d) 0.478

$$Y_p = \frac{P_p}{P_T} = \frac{P_p^0 X_p}{P_p^0 X_p + P_h^0 X_h} = \frac{440 \times \frac{1}{5}}{440 \times \frac{1}{5} + 120 \times \frac{4}{5}}$$

$$= \frac{88}{88+96} = \frac{88}{184} = 0.478$$

$$X_A = \frac{n_A}{n_A + n_B}$$

$$X_p = \frac{1}{5}, \quad X_h = \frac{4}{5}$$

$$\frac{?}{2}$$

Case = 2 ⇒ If one liquid is nonvolatile nature

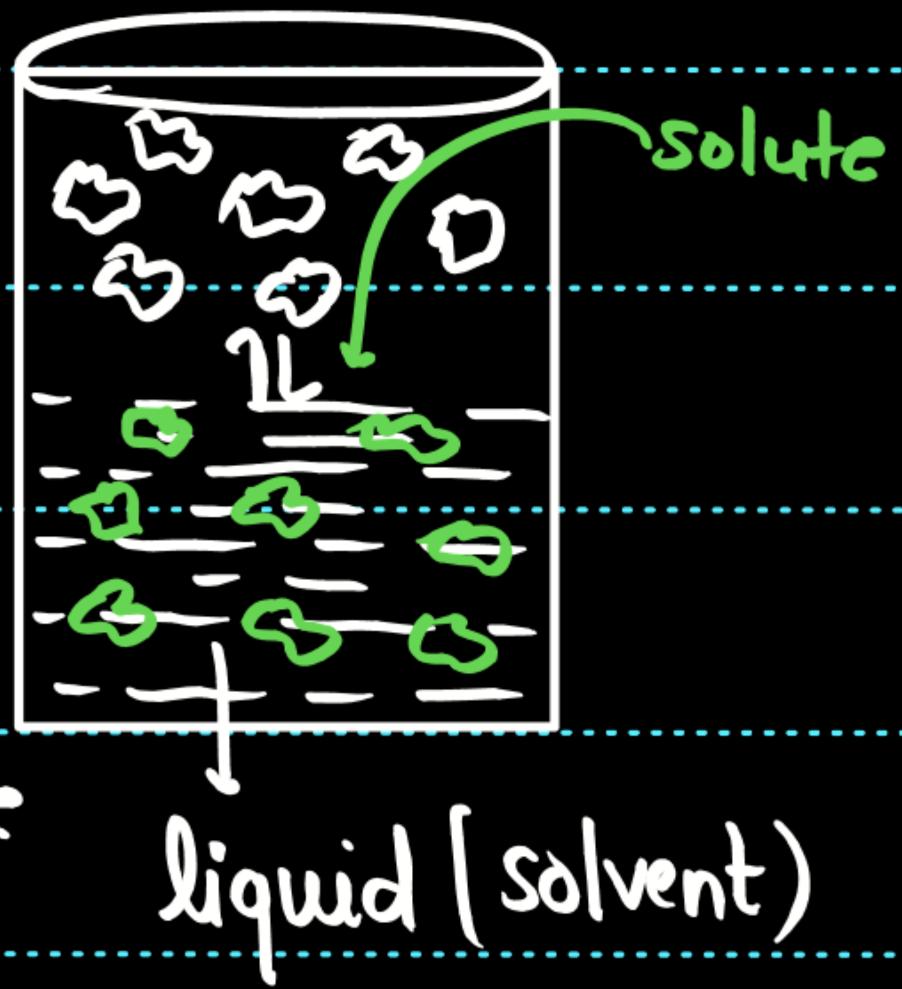
Binary Solution = 2 Component
- ① → solute = non-volatile natur
- ② → solvent = volatile nature

Nonvolatile nature liquid = does not form vapour

$$P_{solute} = P_A^0 = 0$$

Solution = solvent + solute

Equilibrium ⇒ Solvent liquid ⇌ solvent vapour
(Solution wala)



According to Raoult's law

$$P_T = P_A^0 X_A + P_B^0 X_B$$

$P_A^0 = 0$ (solute) → nonvolatile

$$P_T = P_B^0 X_B$$

$P_T \rightarrow P_s$, $P_B^0 \rightarrow P_0$

$$\boxed{P_s = P_0 X_B}$$

$X_A + X_B = 1$

$$\Rightarrow P_s = P_0(1 - X_A)$$

$$\Rightarrow P_s = P_0 - P_0 X_A$$

$$P_s = P_o - P_o X_A$$

$$P_o X_A = P_o - P_s$$

$$P_o - P_s = P_o X_A$$ ⇒ $P_o > P_s$ ⇒ In presence of nonvolatile solute, v.p. of solution decreases

(+ve)(+ve)

$x - y = +ve \Rightarrow x > y$

Lowering of vapour pressure (L.V.P.) ⇒ Nonvolatile solute milne se vap. pressure Kitna Kam ho gaya hai

$(P_o - P_s)$

13:3

$P_o - P_s = P_o X_A$

$$\frac{P_o - P_s}{P_o} = X_A$$

Relative lowering of v.p. in presence of nonvolute solute (R.L.V.P)

(Kitne fraction v.p. of solⁿ Kam ho gaya hai, nonvolatile solute milne se)

percentage = fraction × 100

$$\left(\frac{P_o - P_s}{P_o}\right) \times 100 = \text{Kitne percen-tage v.p. of sol}^n \text{ Kam ho gaya hai, nonvolatile solute milne se}$$

$$\frac{P_0 - P_s}{P_0} = X_A = \frac{n_A}{n_A + n_B}$$

$$\boxed{\frac{P_0 - P_s}{P_0} = \frac{n_A}{n_A + n_B}}$$

diluted solution → $n_B >>> n_A$

$$n_A + n_B \simeq n_B$$

$$\boxed{\frac{P_0 - P_s}{P_0} \simeq \frac{n_A}{n_B}}$$

Note ⇒ $\frac{P_0 - P_s}{P_0} = \frac{n_A}{n_A + n_B}$

$$\frac{P_0}{P_0 - P_s} = \frac{n_A + n_B}{n_A} = \frac{n_A}{n_A} + \frac{n_B}{n_A}$$

$$\frac{P_0}{P_0 - P_s} = 1 + \frac{n_B}{n_A}$$

$$\frac{P_0}{P_0 - P_s} - \frac{1}{1} = \frac{n_B}{n_A} \Rightarrow \frac{P_0 - P_0 + P_s}{P_0 - P_s} = \frac{n_B}{n_A}$$

$$P_s / P_0 - P_s = \frac{n_B}{n_A}$$

$$\frac{P_0 - P_s}{P_s} = \frac{n_A}{n_B}$$

→ universal formula

→ all type of solⁿ

Q→ 2 mole urea dissolve in 1 litre water and After 10 minute further 2 mole urea involve in solution, Select correct Statements.

a) ✗ v.p. of solⁿ increases ($P_s \propto \frac{1}{n_{solute}}$

~~b)~~ lowering of v.p. increases ($P_0 - P_s \propto X_A \propto n_A$)

c) v.p. of solvent increases ($P_0 = Const$)

d) All Correct

Q → In presence of sucrose, the v.p. of solution decreases 20%, Calculate (v.p. of water (P_w°) = 100 mm of Hg)

a) Mole fraction of solute = $\boxed{\frac{1}{5}}$

b) Lowering of v.p. = $\boxed{20 mm}$

a) $\frac{P_o - P_s}{P_o} \times 100 = 20$, $\frac{P_o - P_s}{P_o} = \frac{1}{5}$

$\frac{P_o - P_s}{P_o} = X_A = \frac{1}{5}$

b) $P_o - P_s = P_o X_A = 100 \times \frac{1}{5} = 20 mm$

CSD → Case = 2 → solute (liq-A) = nonvolatile ($P_A^\circ = 0$)

→ $P_s = P_0 X_B$

→ $P_0 - P_s = P_0 X_A$

→ $P_0 > P_s$ = Nonvolatile solute milne se v.p. of solⁿ decrease krta hai ⇒ Reason ⇒ Scaping tendency of solvent molecule decreases due to decreasing of surface Area

→ $P_0 - P_s$ = Lowering of vap. pressure in presence of nonvolatile solute

(Meaning = Kitna v.p. Kam ho gaya hai, nonvolatile solute milne

→ $P_0 - P_s \propto X_A \propto$ Mole of solute

→ $P_s \propto \dfrac{1}{X_A \text{ or mole of solute}}$

$$\frac{P_0 - P_s}{P_0} = X_A$$

$\frac{P_0 - P_s}{P_0}$ = Relative Lowering of v.p. (R.L.V.P.)

↓

(Kitne fraction v.p. Kam ho gaya hai, nonvolatile solute milne se)

$\left(\frac{P_0 - P_s}{P_0}\right) \times 100$ = Kitne percentage v.p. of sol^n Kam ho gaya hai, nonvolatile solute milne se

Raoult's law Relative Lowering of v.p. of sol^n is equal to mole fraction of solute.

$$\left(\frac{P_0 - P_s}{P_0}\right) \propto X_A \propto \text{Mole of solute}$$

$$\frac{P_0 - P_s}{P_0} = \frac{n_A}{n_A + n_B} \Rightarrow \frac{P_0 - P_s}{P_s} = \frac{n_A}{n_B}$$ → universal formula

all type of solⁿ

$$\frac{P_0 - P_s}{P_0} \approx \frac{n_A}{n_B}$$ → only for dilute solⁿ $\left(\frac{n_A}{n_B} = \frac{X_A}{X_B} \right)$

$$\frac{P_0 - P_s}{P_s} = \frac{W_A}{M_A} \times \frac{M_B}{W_B}$$

$$\frac{P_0 - P_s}{P_s} = \frac{X_A}{X_B} = \frac{\text{molality} \times \text{M.wt of solvent}}{1000}$$

Q46. According to Raoult's law, relative lowering of vapour pressure of a solution is equal to **[CBSE AIPMT 1995]**

(a) moles of solute

(b) moles of solvent

(c) mole fraction of solute

(d) mole fraction of solvent

$$\frac{P_0 - P_s}{P_0} = x_A$$

Q40. The vapour pressure of a solvent decreased by 10 mm in two columns of mercury when a non-volatile solute was added to the solvent. The mole fraction of the solute in the solution is 0.2. What should be the mole fraction of the solvent if the decrease in the vapour pressure is to be 20 mm of mercury [CBSE AIPMT 1998]

(a) 0.8

(b) 0.6

(c) 0.4

(d) 0.2

Q44. The vapour pressure, at a given temperature, of an ideal solution containing 0.2 mole of a non-volatile solute and 0.8 mole of solvent is 60 mm of Hg. The vapour pressure of the pure solvent at the same temperature is **[CBSE AIPMT 1996]**

(a) 150 mm of Hg

(b) 60 mm of Hg

(c) 75 mm of Hg

(d) 120 mm of Hg

$$\frac{P_0 - P_s}{P_s} = \frac{n_A}{n_B} \Rightarrow \frac{P_0 - 60}{60} = \frac{0.2}{0.8} = \frac{1}{4}$$

$$P_0 - 60 = \frac{1}{4} \times 60 = 15$$

$$P_0 = 60 + 15 = 75$$

Q45. Vapour pressure of benzene at 30ºC is 121.8 mm. When 15g of a non-volatile solute is dissolved in 250g of benzene its vapour pressure decreased to 120.2 mm. The molecular weight of the solute is (mol. Weight of solvent = 78) [CBSE AIPMT 1995]

(a) 356.2

(b) 456.8

(c) 530.1

(d) 656.7

Right

$$\frac{P_0 - P_s}{P_s} = \frac{n_A}{n_B} = \frac{W_A \times M_B}{M_A \times W_B}$$

$$\frac{121.8 - 120.2}{120.2} = \frac{15}{M_A} \times \frac{78}{250}$$

1.6

$$M_A = 351.58$$

Wrong

$$\frac{P_0 - P_s}{P_0} = \frac{n_A}{n_B} = \frac{W_A}{M_A} \times \frac{M_B}{W_B}$$

$$\frac{121.8 - 120.2}{121.8} = \frac{15}{M_A} \times \frac{78}{250}$$

$$M_A = 356.265$$

Q38. The vapour pressure of benzene at a certain temperature is 640 mm Hg. A non-volatile and non-electrolyte solid, weighing 2.175 g is added to 39.08g of benzene. If the vapour pressure of the solution is 600 mm Hg, what is the molecular weight of solid substance?

[CBSE AIPMT 1999]

(a) 49.50

(b) 59.60

(c) 69.40

(d) 79.82

Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 298 K are 200 mm Hg and 415 mm Hg respectively. (i) Calculate the vapour pressure of the solution prepared by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl_2 at 298 K and, (ii) mole fractions of each component in vapour phase.

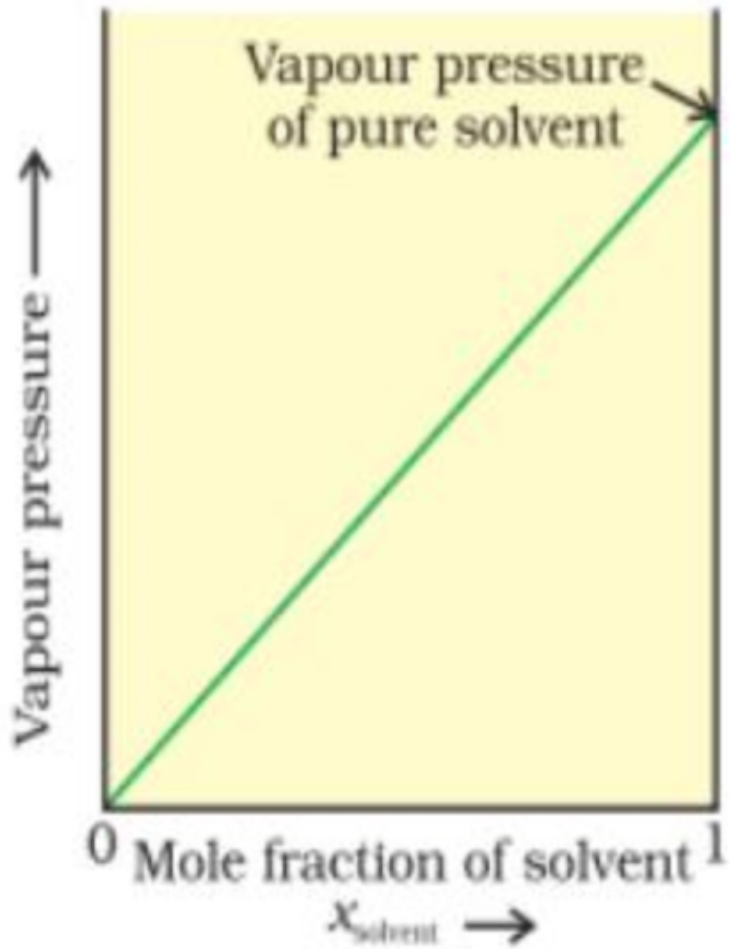
Example 1.5

Solution

Intext Question

1.8 The vapour pressure of pure liquids A and B are 450 and 700 mm Hg respectively, at 350 K. Find out the composition of the liquid mixture if total vapour pressure is 600 mm Hg. Also find the composition of the vapour phase.

Fig. 1.5
If a solution obeys Raoult's law for all concentrations, its vapour pressure would vary linearly from zero to the vapour pressure of the pure solvent.




THANK YOU

MANTHAN NEET 2025

CHEMISTRY

Liqiud solution

Lecture-05



Sarvesh Sir

Today's Goal -

Vapour pressure
Raoult's law

Qsd-1

sol^n-A = 60 gram Urea dissolve in 90 gram water

60g = 1 mole

sol^n-B = 180 gram Urea dissolve in 90 gram water

$\frac{180}{60}$ = 3 mole

Select Correct option

a) $P_A > P_B$ ✓

b) $P_A < P_B$

c) $P_A = P_B$

d) Can not say

nonvolatile solute → v.p. → decreases

$P_0 - P_s \propto X_A$

$P_s \propto \frac{1}{X_A}$

Qsd-2 Urea dissolve in 900 gram water and v.p. of solⁿ decreases 40%, Calculate mole fraction of Urea in solution

a) 0.4

b) 0.6

c) 0.2

d) 0.5

$$\left(\frac{P_0 - P_s}{P_0}\right) \times 100 = 40$$

$$\frac{P_0 - P_s}{P_0} = 0.4$$

$$\frac{P_0 - P_s}{P_0} = X_A = 0.4$$

$$\frac{?}{2}$$

Q40. The vapour pressure of a solvent decreased by 10 mm in two columns of mercury when a non-volatile solute was added to the solvent. The mole fraction of the solute in the solution is 0.2. What should be the mole fraction of the solvent if the decrease in the vapour pressure is to be 20 mm of mercury [CBSE AIPMT 1998]

(a) 0.8

(b) 0.6

(c) 0.4

(d) 0.2

$P_0 - P_s = 10mm \rightarrow \frac{P_0 - P_s}{P_0} = X_A \Rightarrow \frac{10}{P_0} = 0.2$ —(1)

$P_0 = \frac{10}{0.2} = 50mm$

$P_0 - P_s = 20mm \rightarrow X_B = ?$

$\frac{20}{P_0} = X_A = 1 - X_B$

$\frac{20}{50} = 1 - X_B \Rightarrow X_B = 1 - \frac{2}{5} = \frac{3}{5} \Rightarrow X_B = 0.6$

Q38. The vapour pressure of benzene at a certain temperature is 640 mm Hg. A non-volatile and non-electrolyte solid, weighing 2.175 g is added to 39.08g of benzene. If the vapour pressure of the solution is 600 mm Hg, what is the molecular weight of solid substance?

[CBSE AIPMT 1999]

(a) 49.50

(b) 59.60

(c) 69.40

(d) 79.82

P_0 (640), P_s (600)

$$\frac{P_0 - P_s}{P_s} = \frac{n_A}{n_B} = \frac{w_A}{M_A} \times \frac{M_B}{w_B}$$

$$\frac{640-600}{600} = \frac{2.175}{M_A} \times \frac{78}{39.08}$$

$$M_A = \frac{2.175 \times 78 \times 600}{40 \times 39.08} = 65.116$$

→ wrong hai

$$\frac{P_0 - P_s}{P_0} = \frac{n_A}{n_B} \rightarrow \text{for dilute sol}^n$$

$$\frac{640-600}{640} = \frac{2.178 \times 78}{M_A \times 39.08}$$

$$M_A = \frac{2.178 \times 78 \times 640}{40 \times 39.08} = 69.45$$

ABB

Intext Question

1.8 The vapour pressure of pure liquids A and B are 450 and 700 mm Hg respectively, at 350 K . Find out the composition of the liquid mixture if total vapour pressure is 600 mm Hg. Also find the composition of the vapour phase.

$P_A^0 = 450 mm$

$P_B^0 = 700 mm$

Q-1, $x_A, x_B = ?$

$P_T = 600 mm$

Q-2, $Y_A, Y_B = ?$

$P_T = (P_A^0 - P_B^0) x_A + P_B^0$

$600 = (450 - 700) x_A + 700$

$600 = -250 x_A + 700$

$-100 = -250 x_A$

$x_A = \frac{100}{250} = \frac{4}{10} = \frac{2}{5}$

$x_B = 1 - x_A = 1 - \frac{2}{5} = \frac{3}{5}$

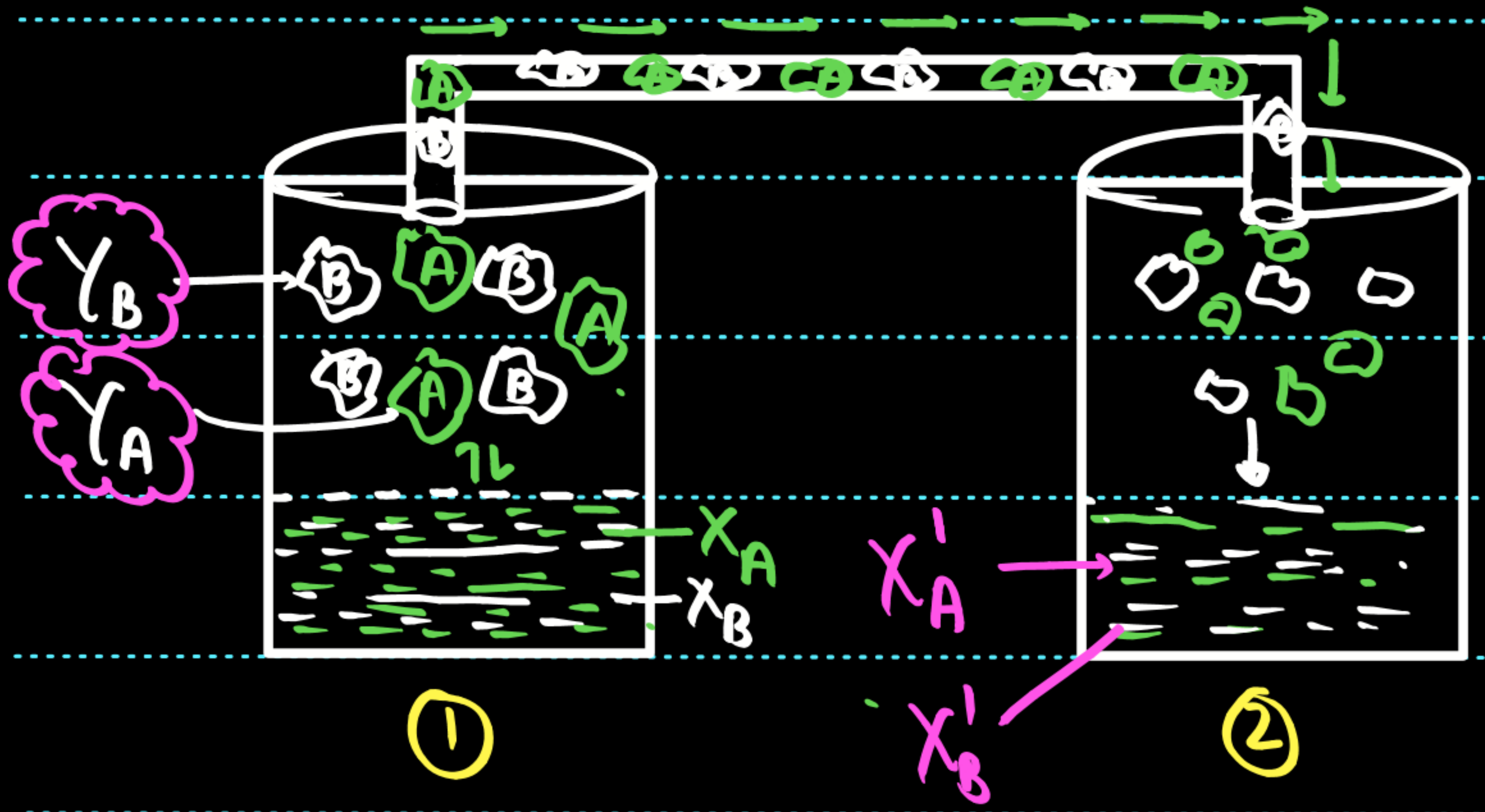
$$Y_A = \frac{P_A}{P_T} = \frac{P_A^0 X_A}{600} = \frac{\overset{90}{\cancel{450}} \times 2/\cancel{5}}{600}$$

$$= \frac{\overset{3}{\cancel{180}}}{\underset{10}{\cancel{600}}} = \frac{3}{10}$$

$$\boxed{Y_A = 3/10}$$

$$Y_B = 1 - Y_A = 1 - 3/10 = \boxed{\frac{7}{10}}$$

Successive distillation



* all vap mixture of Container-1 pas through tube in Container-2 and Condense

Mole fraction of liq-A in Condense phase $(X'_A) = Y_A$

Mole fraction of liq-B in Condense phase $(X'_B) = Y_B$

Q Mole fraction of liquid-A in vapour phase is 0.4, If Vapour of liq-A & liq-B Condense in other Container than Calculate mole fraction of liq-B in Condense phase

a) 0.4

~~b)~~ 0.6

c) 0.2

d) 0.5

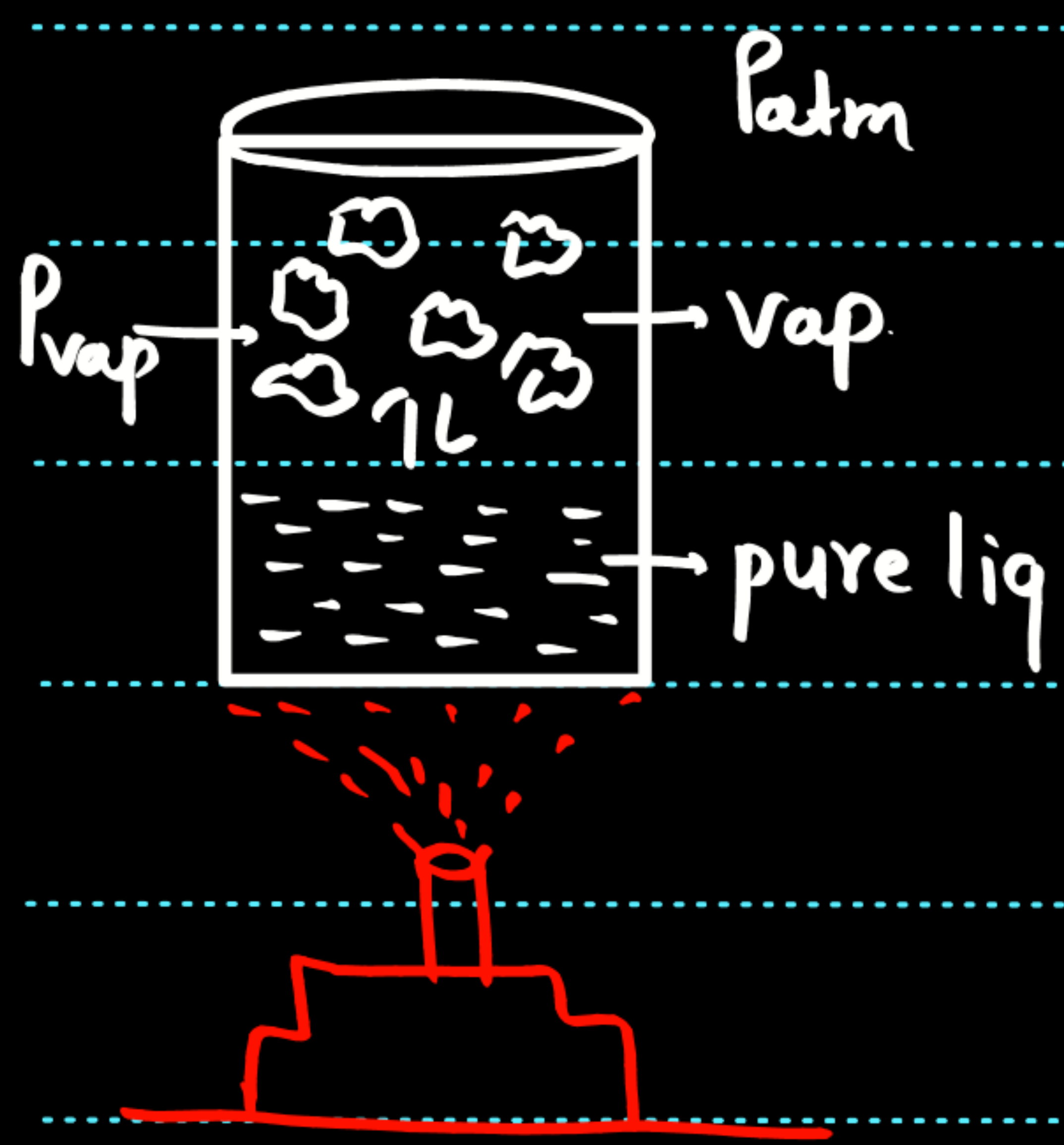
liq-A → $Y_A = 0.4$
liq-B → $Y_B = 0.6$
→ $X'_A = 0.4$, $X'_B = 0.6$

$Y_A + Y_B = 1$

$0.4 + Y_B = 1$

$Y_B = 1 - 0.4 = 0.6$

Boiling point of pure liquid



$P_{vap} = P_{atm}$ ⇒ At that temp., vapour pressure of liquid is equal to P_{atm}

$P_{vap} = P_{atm} = 1 atm$

B.P. ∝ P_{atm}

B.P. = 100°C → P_{atm} = 1 atm water

B.P. = 50°C → P_{atm} = ½ atm

B.P. = 200°C → P_{atm} = 2 atm

Q → B.P. of water in Sarvesh Sir home is 100°C at 1atm pressure, If atomspheric pressure of Sarvesh Sir home is 2atm. the B.P of water may be

a) B.P. of water = 100°C

B.P ∝ P_{atm}

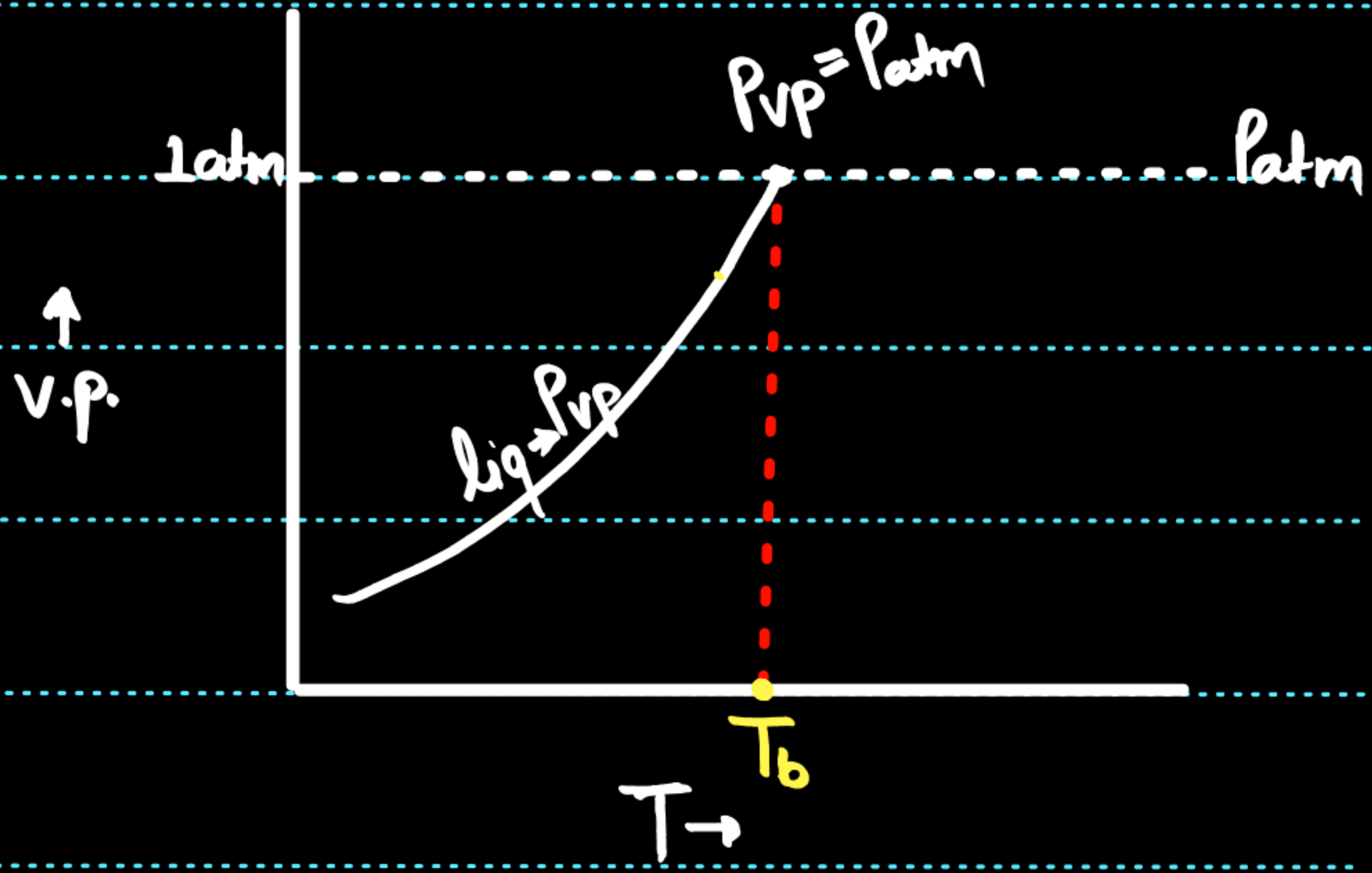
b) B.P. of water > 100°C

c) B.P. of water < 100°C

d) Can not say

→ V.P. $\propto$ temp.

→ V.P. $\propto \frac{1}{B.P.}$

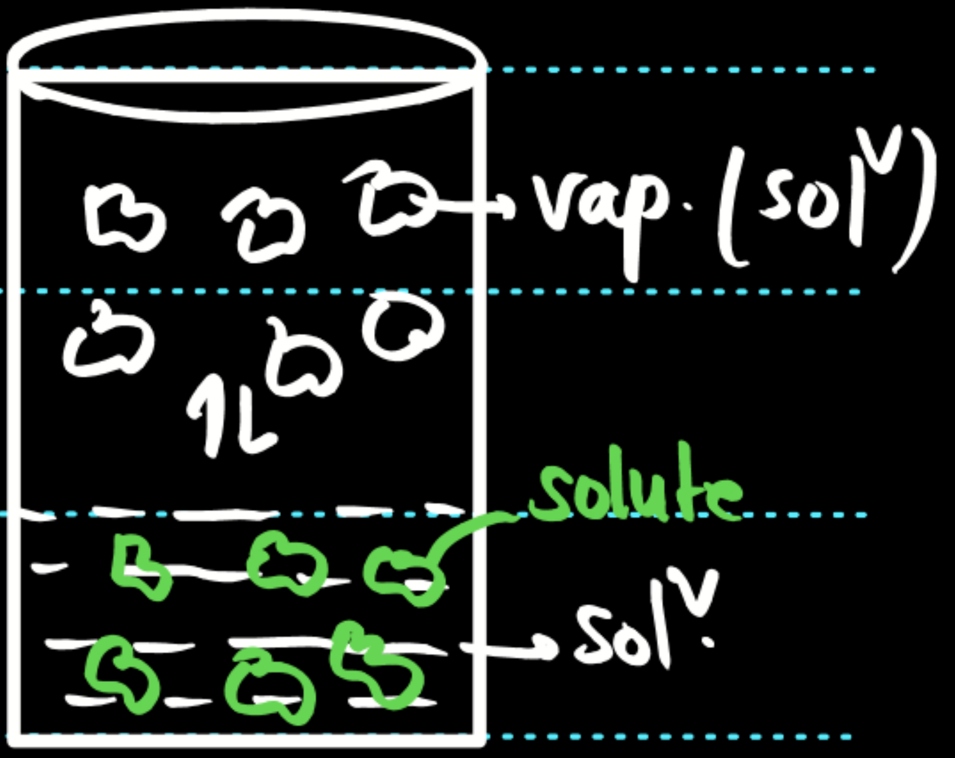


Boiling point of binary solution

solute = nonvolatile solute = Vapour nahi form Karenga

Solvent = Volatile nature

At Equilibrium = liquid (Solvent) $\rightleftharpoons$ vapour (sol^n)



$\rightarrow$ $B.P. \propto \frac{1}{V.P.}$

Nonvolatile solute milate ho → $P_0 > P_s$ ⇒ decrease (vap. pressure)

than B.P. → increase

$(T_b)_0$ = b.p. of solvent

$(T_b)_s$ = b.p. of solution

$(T_b)_s > (T_b)_0$

Elevation of Boiling point (ΔT_b)

$\Delta T_b = (T_b)_{soln} - (T_b)_{solvent}$

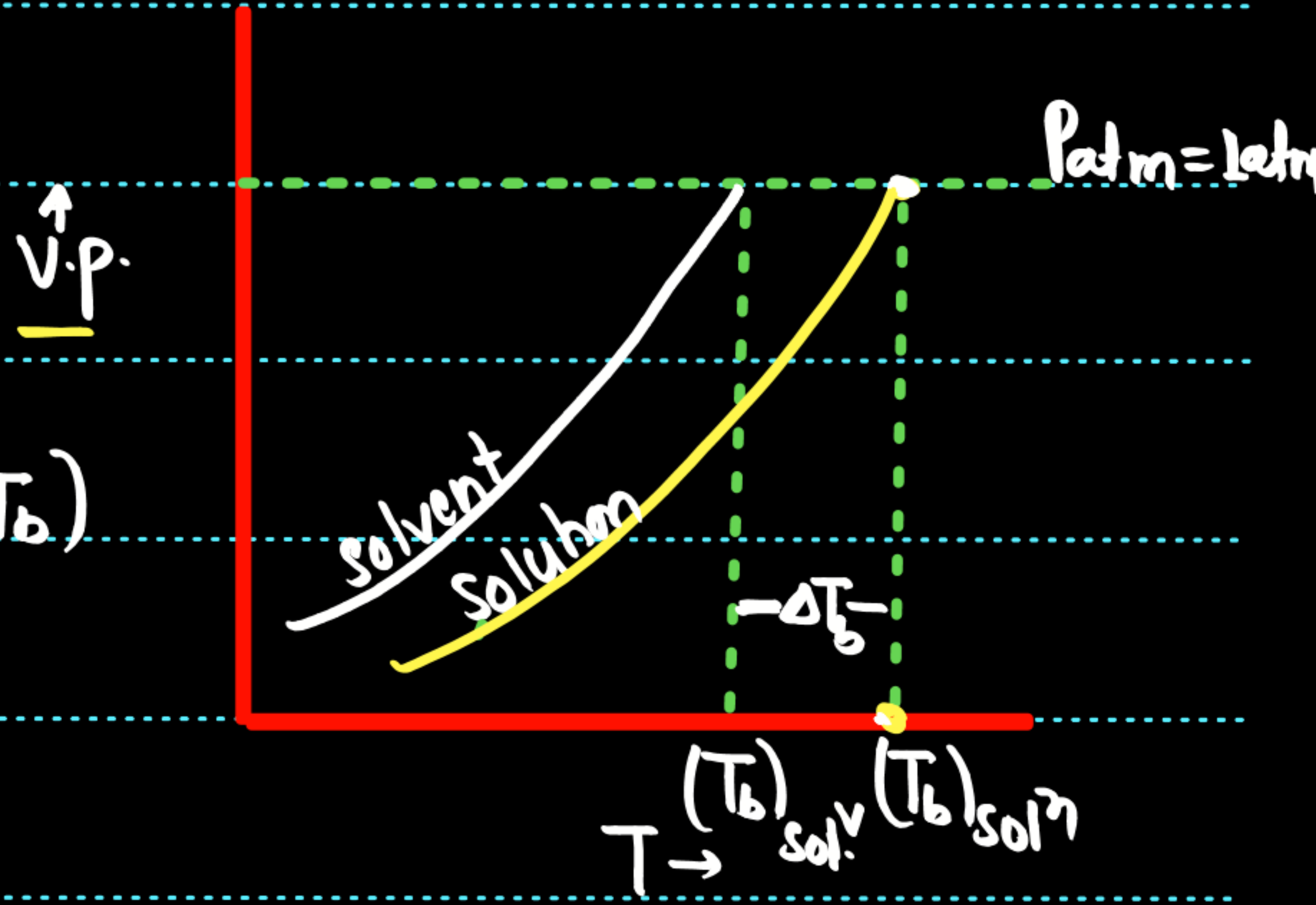
↓

difference in b.p. of solⁿ & solvent

↓

elevation of b.p.

$\Delta T_b \propto$ molality of solution (m)



$\Delta T_b \propto m$

$$\boxed{\Delta T_b = K_b m}$$

ΔT_b = elevation of b.p.

m = molality of solⁿ

K_b = elevation const for solvent (Ebulloscopic Constant)

↓

not depend upon solute nature (only depend upon solvent nature)

CSP

Boiling Point ⇒ $T = B.P \rightarrow P_{vap} = P_{atm}$

→ $B.P \propto P_{atm}$

***

→ At Boinling point of liquid → $P_{vap} = P_{atm} = 1 atm = 760$ mm of Hg

elevation of b.p. $(\Delta T_b) = (T_b)_{soln} - (T_b)_{solv.}$

→ $(T_b)_{solution} \propto$ Mole of nonvolatile solute

→ $(\Delta T_b) \propto$ mole of solute

→ $\Delta T_b = K_b \cdot m$

→ $\Delta T_b \propto m$, $\Delta T_b \propto \frac{n_{solute}}{(Mass)_{solvent}} \times 10^3$

→ $(T_b)_{soln} \propto m$

→ $\Delta T_b \propto K_b$ (m = Const)

→ $(T_b)_{soln.} \propto K_b$ (m = Const)

unit of $K_b = \frac{\Delta T_b}{m} = \frac{K}{\frac{mole}{kg}}$

$= mole^{-1} kg \times K$

Q → 10g Urea in 100g water → solⁿ A $\Rightarrow \frac{10}{60} = \frac{1}{6}$

20g Urea in 100g water → solⁿ B $= \frac{20}{60} = \frac{1}{3}$

Select Correct option

a) $(T_b)_A = (T_b)_B$ — $(T_b)_{soln} \propto$ mole of solute

b) $(T_b)_A > (T_b)_B$

c) $(T_b)_A < (T_b)_B$ — B.P. $\propto \frac{1}{V.P.}$

d) $(P_{vap})_A > (P_{vap})_B$

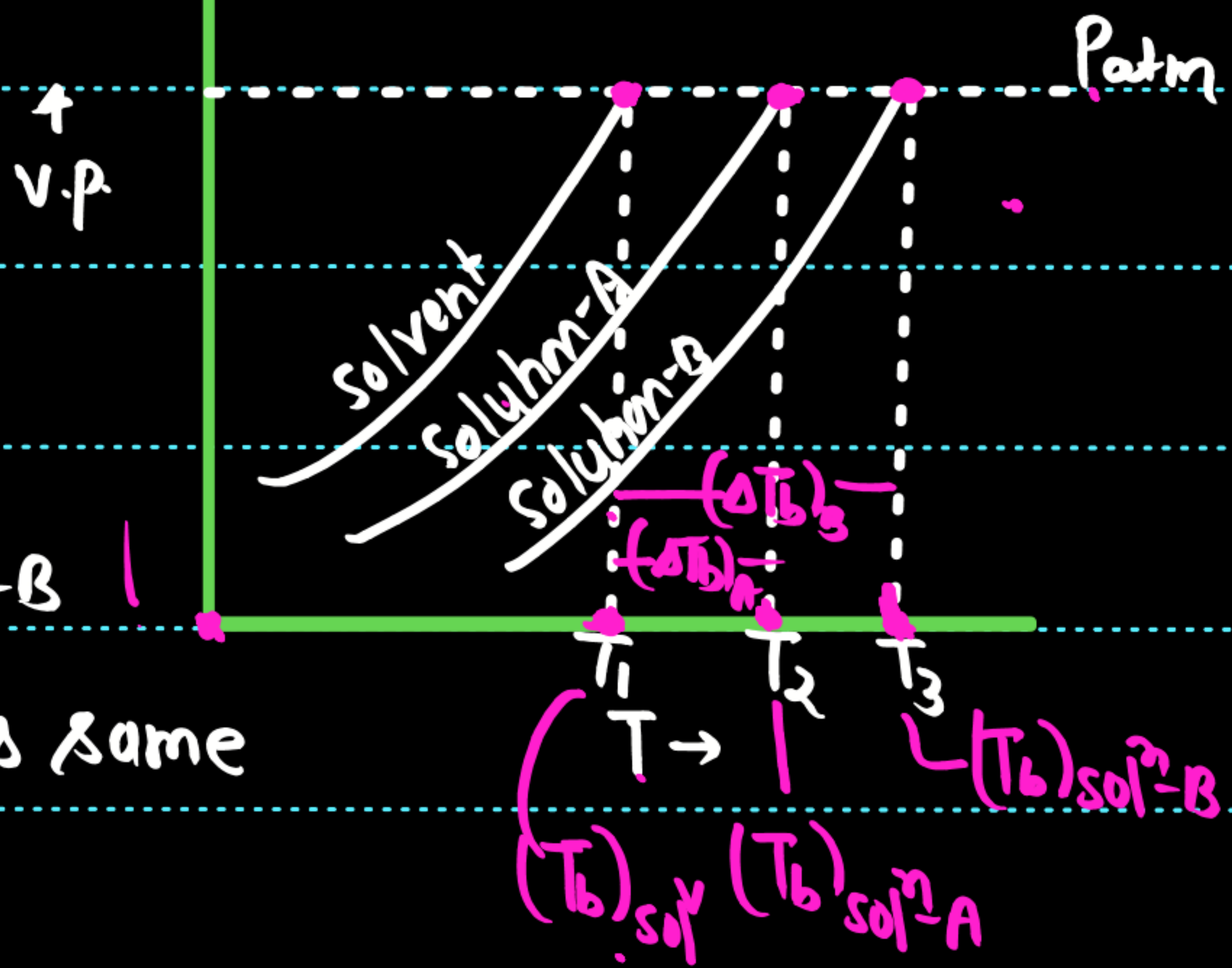
Select Correct statements

a) elevation of b.p. of sol^n-B is greater than of sol^n-A

b) b.p. of sol^n-A is less than sol^n-B

c) Value of K_b for sol^n-A & sol^n-B is same

d) All Correct




THANK
YOU

MANTHAN NEET 2025

CHEMISTRY

Liqiud solution

Lecture-05



Sarvesh Sir

Today's Goal -

Vapour pressure
Raoult's law

Qsd-1 Sol^n-A = 60 gram urea dissolve in 90 gram water

$\frac{60}{60} = 1$ mole

Sol^n-B = 180 gram Urea dissolve in 90 gram water

$\frac{180}{60} = 3$ mole

Select Correct option

a) $P_A > P_B$ ✓

b) $P_A < P_B$

c) $P_A = P_B$

d) Can not say

nonvolatile solute → v.p. → decreases

$P_0 - P_s \propto X_A$

$P_s \propto \frac{1}{X_A}$

Qsd-2 Urea dissolve in 900 gram water and v.p. of solⁿ decreases 40%, Calculate mole fraction of Urea in solution

~~a) 0.4~~

b) 0.6

c) 0.2

d) 0.5

$$\left(\frac{P_0 - P_s}{P_0}\right) \times 100 = 40$$

$$\frac{P_0 - P_s}{P_0} = 0.4$$

$$\frac{P_0 - P_s}{P_0} = X_A = 0.4$$

$$\frac{?}{2}$$

Q40. The vapour pressure of a solvent decreased by 10 mm in two columns of mercury when a non-volatile solute was added to the solvent. The mole fraction of the solute in the solution is 0.2. What should be the mole fraction of the solvent if the decrease in the vapour pressure is to be 20 mm of mercury [CBSE AIPMT 1998]

(a) 0.8

(b) 0.6

(c) 0.4

(d) 0.2

$P_0 - P_s = 10mm \rightarrow \frac{P_0 - P_s}{P_0} = X_A \Rightarrow \frac{10}{P_0} = 0.2$ —(1)

$P_0 = \frac{10}{0.2} = 50mm$

$P_0 - P_s = 20mm \rightarrow X_B = ?$

$\frac{20}{P_0} = X_A = 1 - X_B$

$\frac{20}{50} = 1 - X_B \Rightarrow X_B = 1 - \frac{2}{5} = \frac{3}{5} \Rightarrow X_B = 0.6$

Q38. The vapour pressure of benzene at a certain temperature is 640 mm Hg. A non-volatile and non-electrolyte solid, weighing 2.175 g is added to 39.08g of benzene. If the vapour pressure of the solution is 600 mm Hg, what is the molecular weight of solid substance?

[CBSE AIPMT 1999] → wrong hai

(a) 49.50

(b) 59.60

(c) 69.40

(d) 79.82

$$\frac{P_0 - P_s}{P_s} = \frac{n_A}{n_B} = \frac{w_A}{M_A} \times \frac{M_B}{w_B}$$

$$\frac{640-600}{600} = \frac{2.175}{M_A} \times \frac{78}{39.08}$$

$$M_A = \frac{2.175 \times 78 \times 600}{40 \times 39.08} = 65.116$$

$$\frac{P_0 - P_s}{P_0} = \frac{n_A}{n_B} \rightarrow \text{for dilute sol}^n$$

$$\frac{640-600}{640} = \frac{2.178 \times 78}{M_A \times 39.08}$$

$$M_A = \frac{2.178 \times 78 \times 640}{40 \times 39.08} = 69.45$$

ABB

Intext Question

1.8 The vapour pressure of pure liquids A and B are 450 and 700 mm Hg respectively, at 350 K. Find out the composition of the liquid mixture if total vapour pressure is 600 mm Hg. Also find the composition of the vapour phase.

$P_A^0 = 450 mm$

$P_B^0 = 700 mm$

Q-1, $x_A, x_B = ?$

$P_T = 600 mm$

Q-2, $Y_A, Y_B = ?$

$P_T = (P_A^0 - P_B^0) x_A + P_B^0$

$600 = (450-700) x_A + 700$

$600 = -250 x_A + 700$

$-100 = -250 x_A$

$x_A = \frac{100}{250} = \frac{4}{10} = \frac{2}{5}$

$x_B = 1 - x_A = 1 - \frac{2}{5} = \frac{3}{5}$

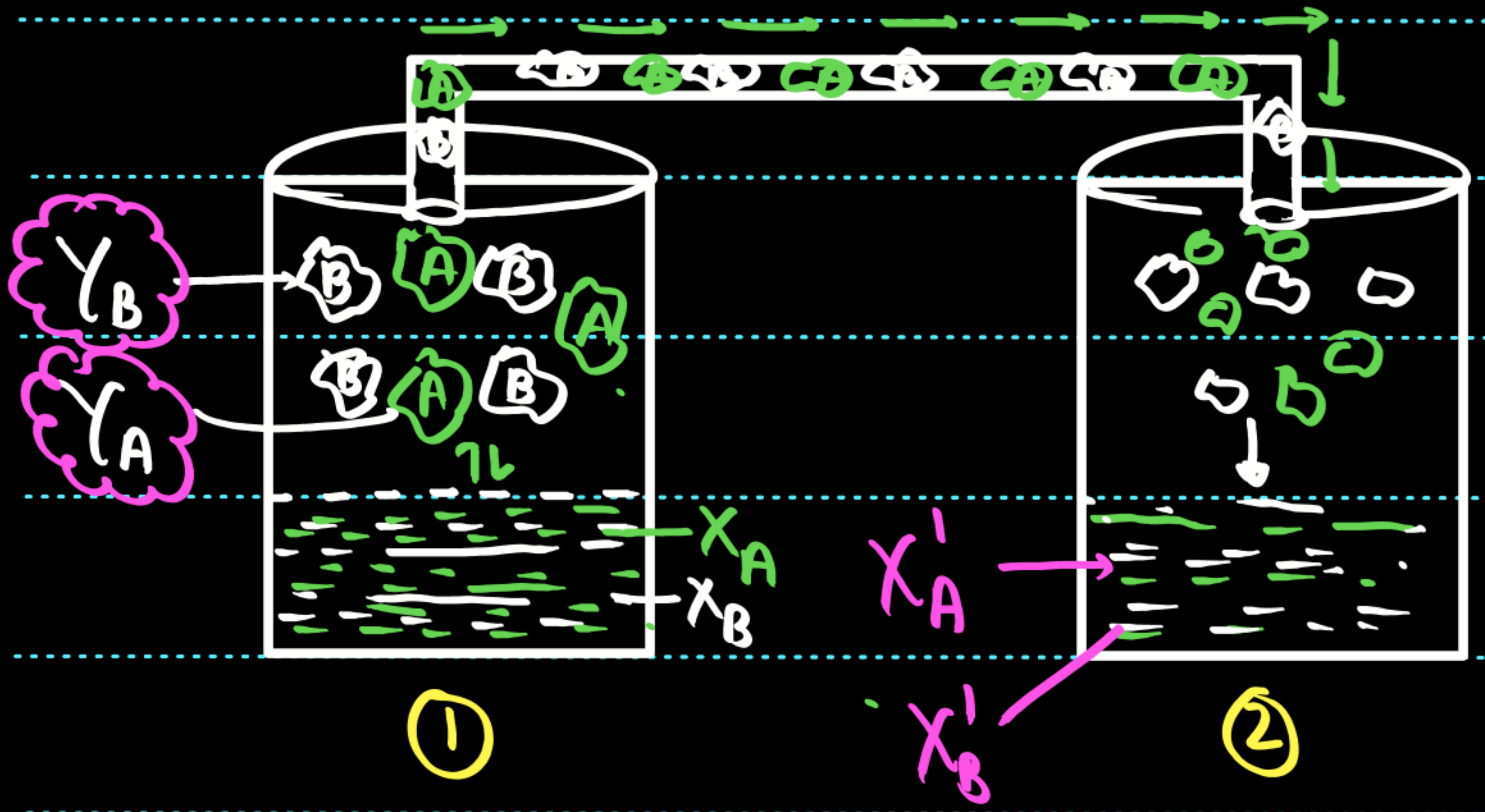
$$Y_A = \frac{P_A}{P_T} = \frac{P_A^0 X_A}{600} = \frac{\overset{90}{\cancel{450}} \times 2/\cancel{5}}{600}$$

$$= \frac{\overset{3}{\cancel{180}}}{\underset{10}{\cancel{600}}} = \frac{3}{10}$$

$$Y_A = 3/10$$

$$Y_B = 1 - Y_A = 1 - 3/10 = \frac{7}{10}$$

Successive distillation



* all vap. mixture of container-1 pas through tube in container-2 and Condense

Mole fraction of liq-A in Condense phase $(X'_A) = Y_A$

Mole fraction of liq-B in Condense phase $(X'_B) = Y_B$

Q Mole fraction of liquid-A in vapour phase is 0.4, If Vapour of liq-A & liq-B Condense in other Container than calculate mole fraction of liq-B in Condense phase

a) 0.4
~~b) 0.6~~
c) 0.2
d) 0.5

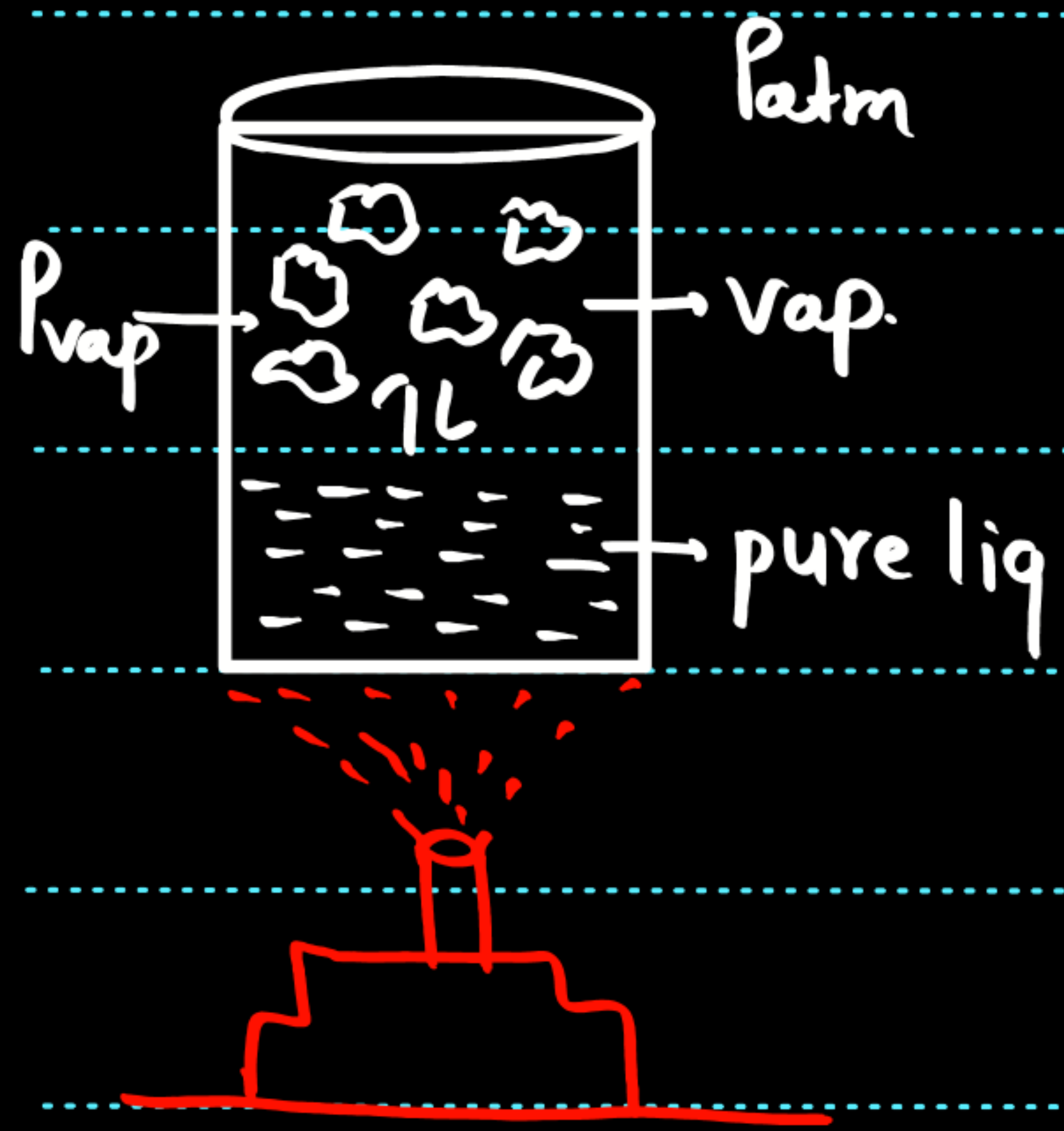
liq-A → $Y_A = 0.4$
liq-B → $Y_B = 0.6$
→ $X'_A = 0.4$, $X'_B = 0.6$

$$Y_A + Y_B = 1$$

$$0.4 + Y_B = 1$$

$$Y_B = 1 - 0.4 = 0.6$$

Boiling point of pure liquid



$P_{vap} = P_{atm}$ ⇒ At that temp., vapour pressure of liquid is equal to P_{atm}

$P_{vap} = P_{atm} = 2\,atm$

B.P. ∝ P_{atm}

B.P. = 100°C → P_{atm} = 1 atm water

B.P. = 50°C → P_{atm} = ½ atm

B.P. = 200°C → P_{atm} = 2 atm

Q → B.P. of water in Sarvesh Sir home is $100°C$ at 1 atm pressure, If atmospheric pressure of Sarvesh Sir home is 2 atm. the B.P. of water may be

a) B.P. of water $= 100°C$

B.P $\propto$ P_{atm}

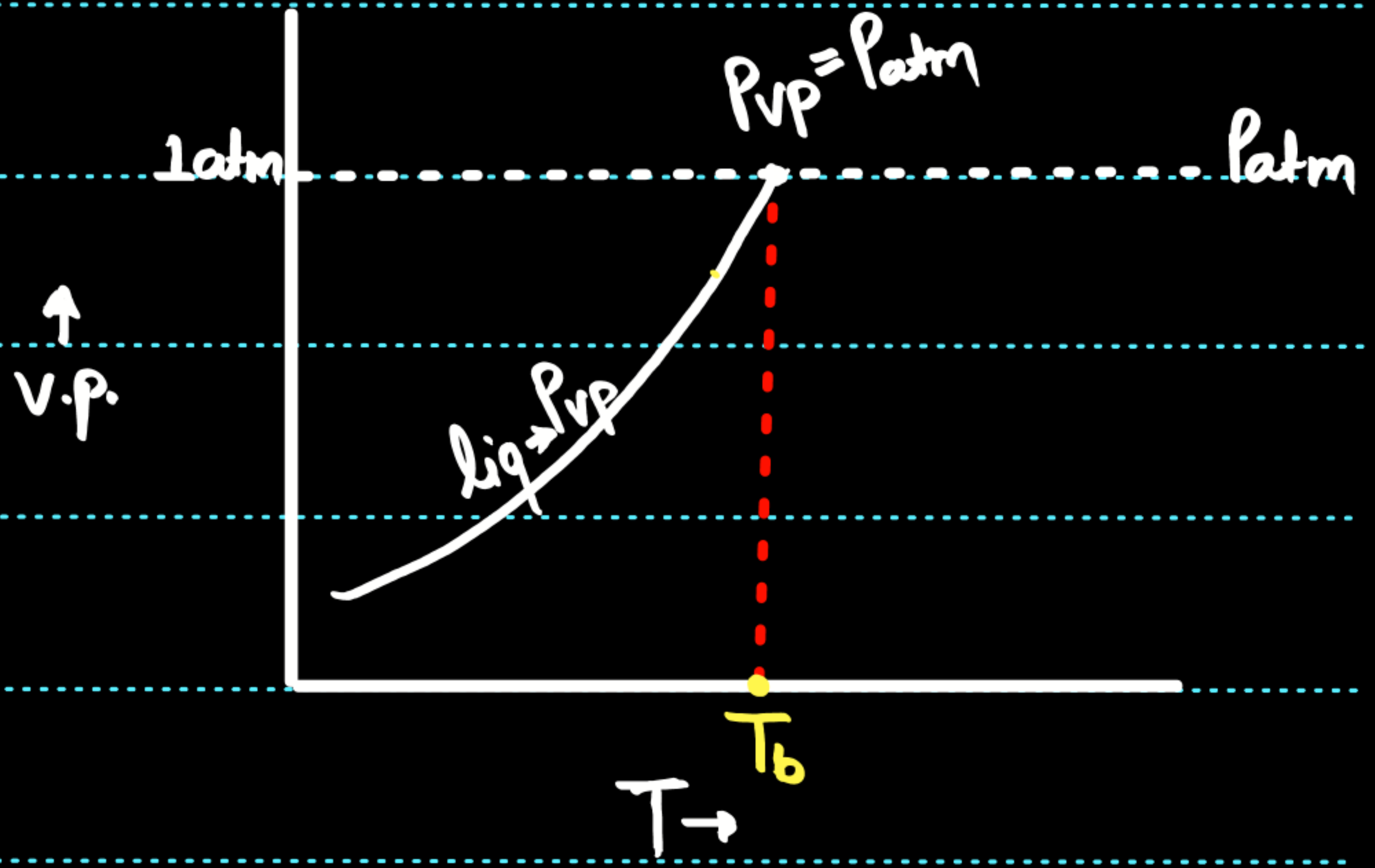
b) B.P. of water $> 100°C$

c) B.P. of water $< 100°C$

d) Can not say

→ V.P. ∝ temp.

→ V.P. ∝ $\frac{1}{B.P.}$

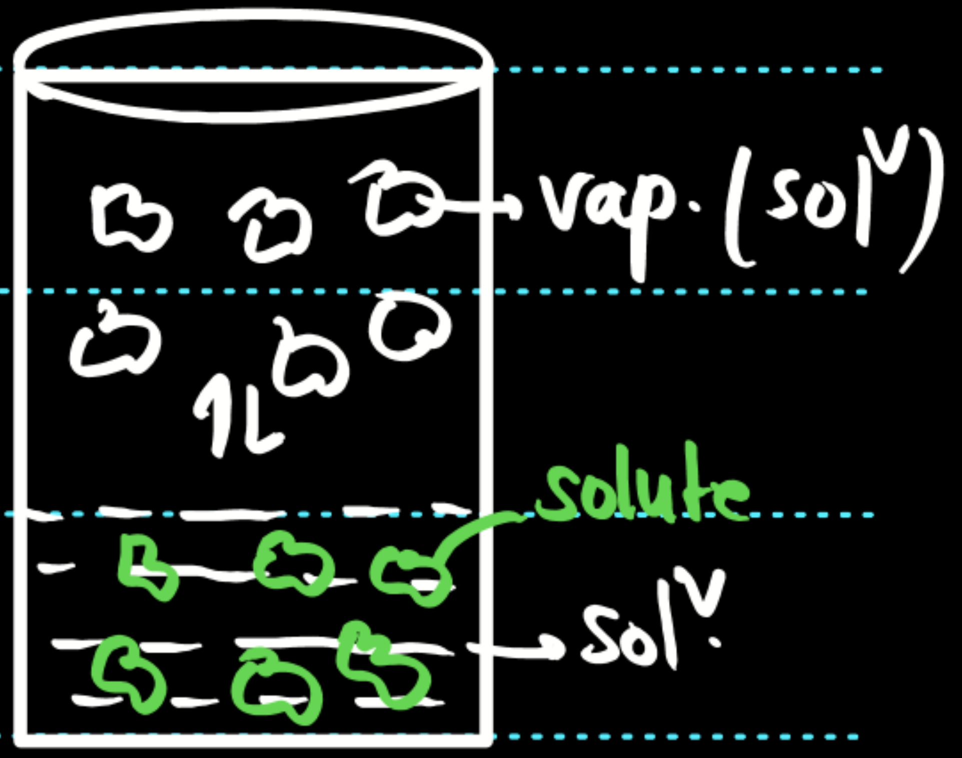


Boiling point of binary solution

Solute = nonvolatile solute = Vapour nahi form Karenga

Solvent = Volatile nature

At Equilibrium = liquid (Solvent) $\rightleftharpoons$ vapour (sol^v)



$\rightarrow$ B.P. $\propto \frac{1}{V.P.}$

Nonvolatile solute milate ho $\rightarrow P_0 > P_s \Rightarrow$ decrease (vap. pressure)

than B.P. $\rightarrow$ increase

$(T_b)_0$ = b.p. of solvent

$(T_b)_s$ = b.p. of solution

$(T_b)_s > (T_b)_0$

Elevation of Boiling point (ΔT_b)

$\Delta T_b = (T_b)_{soln} - (T_b)_{solvent}$

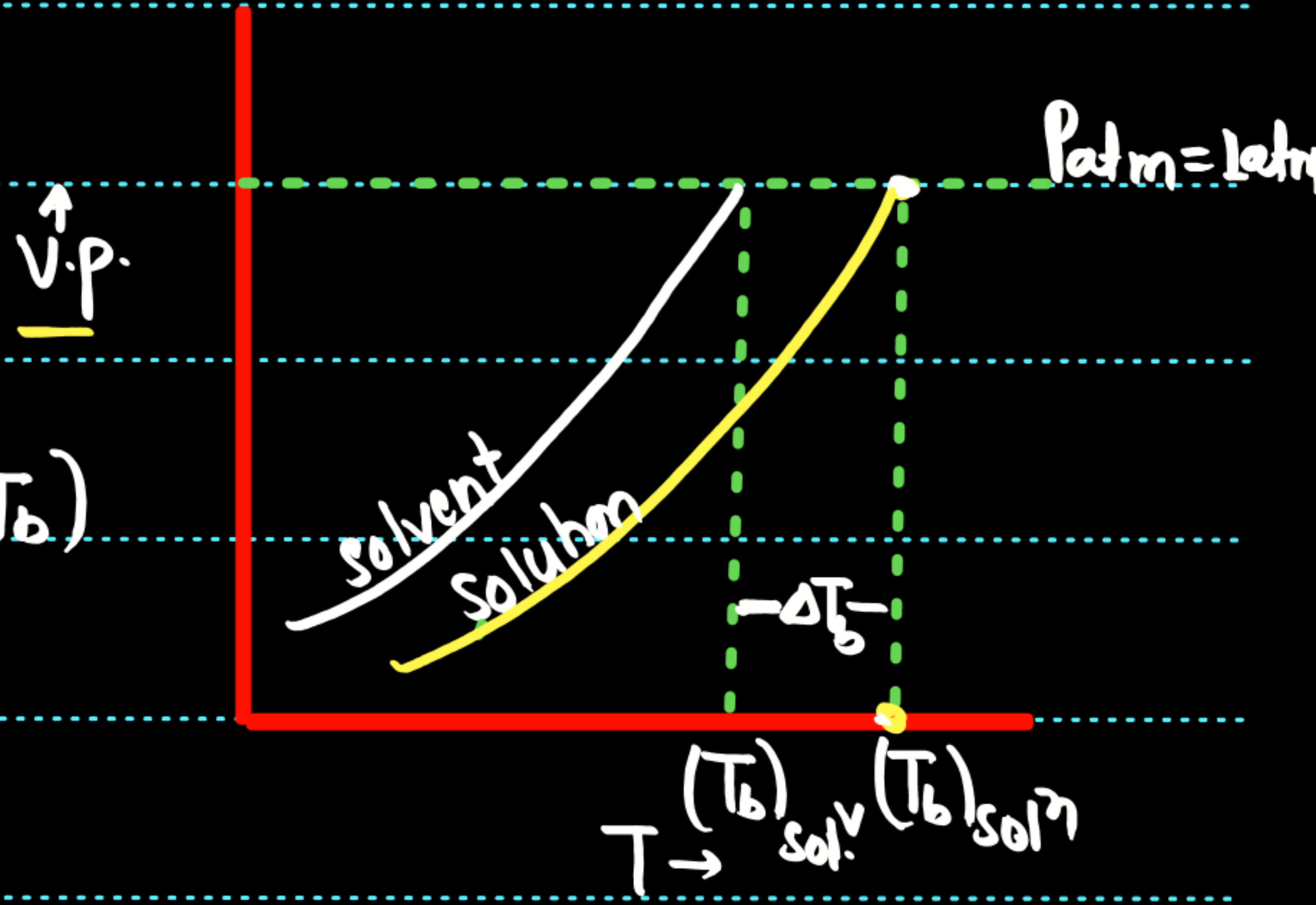
↓

difference in b.p. of soln & solvent

↓

elevation of b.p.

$\Delta T_b \propto$ molality of solution (m)



$\Delta T_b \propto m$

$$\Delta T_b = K_b m$$

ΔT_b = elevation of b.p.

m = molality of sol^n

K_b = elevation const for solvent (Ebulloscopic Constant)

↓

not depend upon solute nature (only depend upon solvent nature)

CSP

Boiling Point ⇒ $T = B.P \rightarrow P_{vap} = P_{atm}$

→ $B.P \propto P_{atm}$

***

→ At Boinling point of liquid → $P_{vap} = P_{atm} = 1\,atm = 760\,mm\ of\ Hg$

elevahon of b.p. $(\Delta T_b) = (T_b)_{sol^n} - (T_b)_{solv.}$

→ $(T_b)_{soluhon} \propto$ Mole of nonvolatile solute

→ $(\Delta T_b) \propto$ mole of solute

→ $\Delta T_b = K_b \cdot m$

→ $\Delta T_b \propto m$, $\Delta T_b \propto \frac{n_{solute}}{(Mass)_{solvent}} \times 10^3$

→ $(T_b)_{sol^n} \propto m$

→ $\Delta T_b \propto K_b$ ($m = Const$)

→ $(T_b)_{sol^n} \propto K_b$ ($m = Const$)

unit of $K_b = \frac{\Delta T_b}{m} = \frac{K}{\frac{mole}{kg}}$

$= mole^{-1}\,kg \times K$

Q → 10g Urea in 100g water → sol^n A $\Rightarrow \frac{10}{60} = \frac{1}{6}$

20g Urea in 100g water → sol^n B $= \frac{20}{60} = \frac{1}{3}$

Select Correct option

a) $(T_b)_A = (T_b)_B$ $\quad (T_b)_{sol^n} \propto$ mole of solute

b) $(T_b)_A > (T_b)_B$

c) $(T_b)_A < (T_b)_B$ $\quad B.P. \propto \frac{1}{V.P.}$

d) $(P_{vap})_A > (P_{vap})_B$

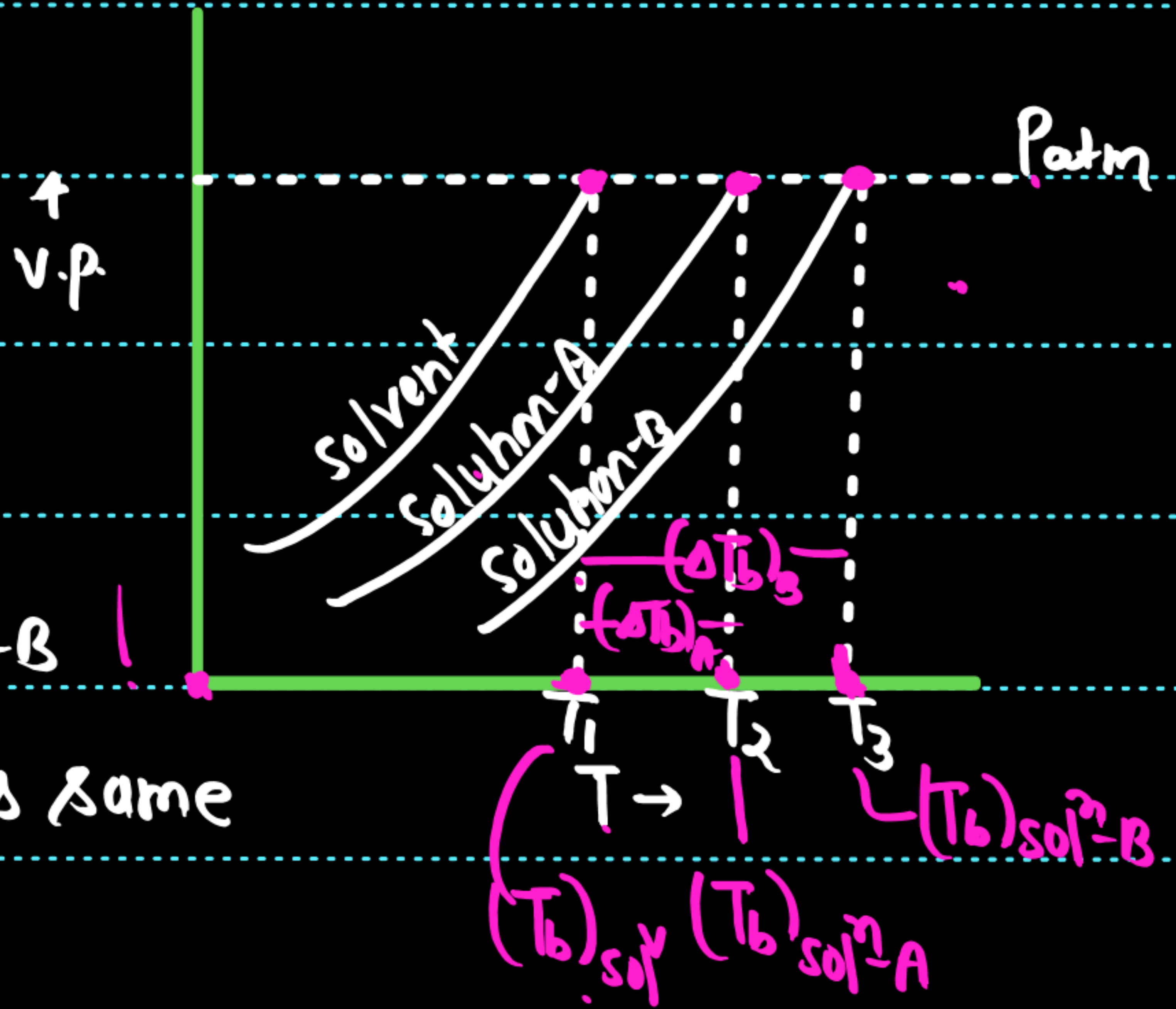
Select Correct statements

a) elevation of b.p. of sol^n-B is greater than of sol^n-A

b) b.p. of sol^n-A is less than sol^n-B

c) Value of K_b for sol^n-A & sol^n-B is same

d) All Correct

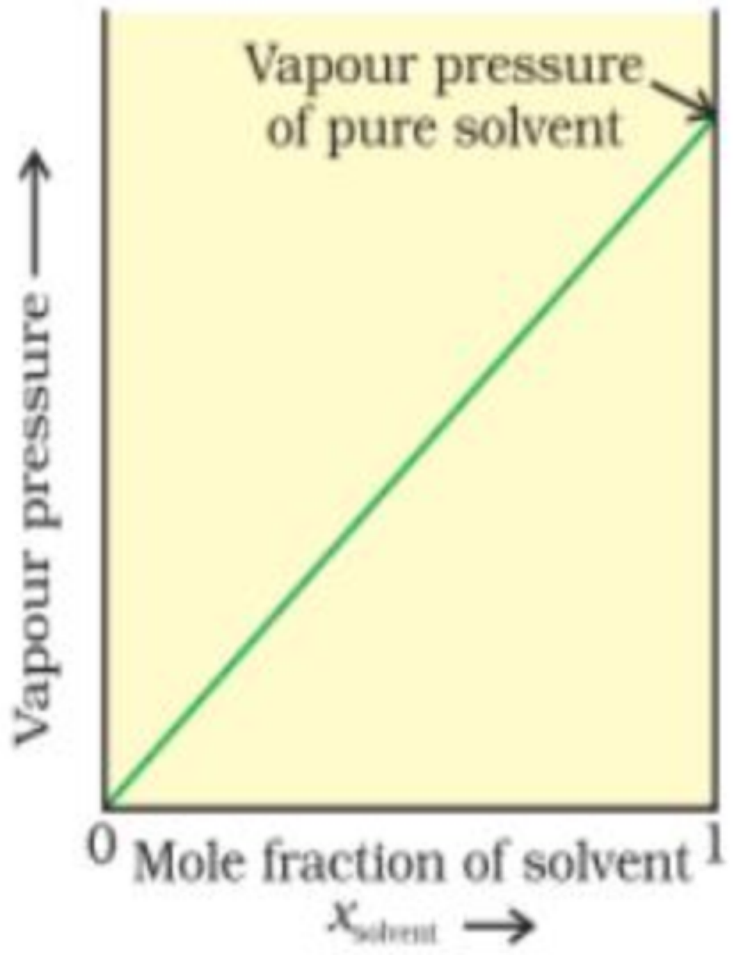


Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 298 K are 200 mm Hg and 415 mm Hg respectively. (i) Calculate the vapour pressure of the solution prepared by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl_2 at 298 K and, (ii) mole fractions of each component in vapour phase.

Example 1.5

Solution

Fig. 1.5
If a solution obeys Raoult's law for all concentrations, its vapour pressure would vary linearly from zero to the vapour pressure of the pure solvent.




THANK YOU

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Telegram → Manthan NEET
Channel

Mole Concept & liquid solution

CHEMISTRY

Liqiud solution

Lecture-06



Sarvesh Sir

Today's Goal -

Freezing point
Osmotic pressure

Qsd-1 Mole fraction of liq-A in binary solⁿ is 0.4. Calculate what fraction of pressure of volatile solvent decreases in present nonvolatile solute-A

(a) $\frac{5}{2}$

✓ (b) $\frac{2}{5}$

(c) $\frac{3}{5}$

(d) NONE.

$$X_A = \frac{P_0 - P_s}{P_0} = R.L.V.P.$$

$$\frac{04}{10} = \frac{2}{5}$$

Kitne fraction v.p. decrease ho gaya hai nonvolatile solute milne se

Qsd-2 10 gram sucrose dissolve in 100 gram H_2O.

Select Correct statements.

(a) v.p. of solⁿ decrease.

(b) $P_0 - P_s \propto X_{sucrose}$

(c) $\frac{P_0 - P_s}{P_0} \propto$ amount of sucrose

(d) All Correct

$$\frac{P_0 - P_s}{P_0} = X_A$$

$$P_0 - P_s = X_A P_0$$

$$P_0 - P_s \propto X_A$$

Qsd-3 B.p. of H_2O in earth ($P_{atm} = 1 atm$) is $100°C$ temp.
select correct option for b.p. of H_2O in moon, suppose
$P_{atm} = 2 atm$ in moon.

(a) $100°C$

(b) $> 100°C$

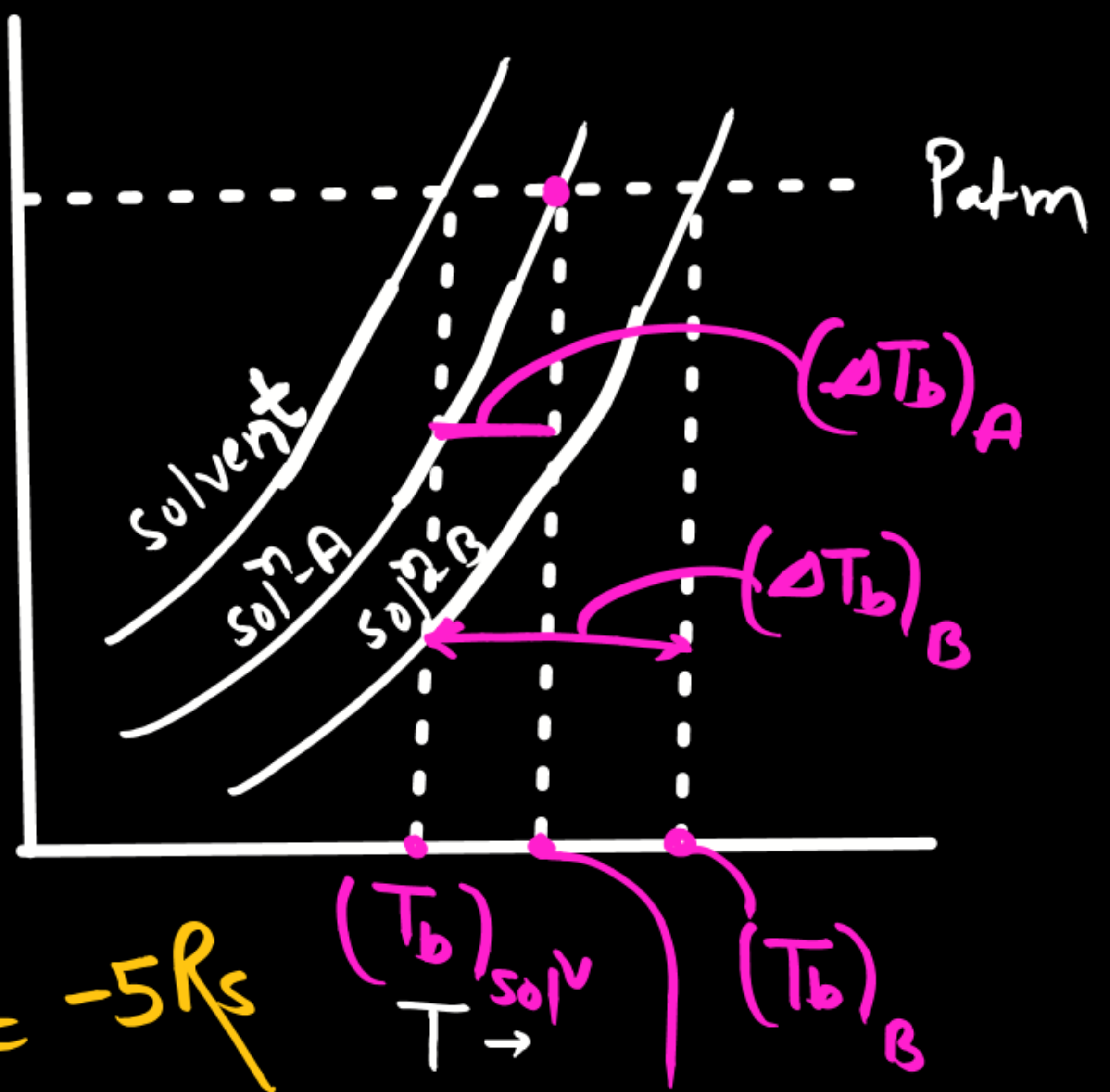
(c) $< 100°C$

(d) NONE of there

Qsd-3

Correct +5 Rs

incorrect = −5 Rs



Select Correct option

(a) sol^n-A = 0.1 m
sol^n-B = 0.1 m ✗

(b) sol^n-A = 0.1 m
sol^n-B = 0.2 m ✓

$m_A < m_B$

(c) sol^n-A = 0.2 m
sol^n-B = 0.2 m ✗

(d) None

40 Sec

$\Delta T_b = K_b m$

↓

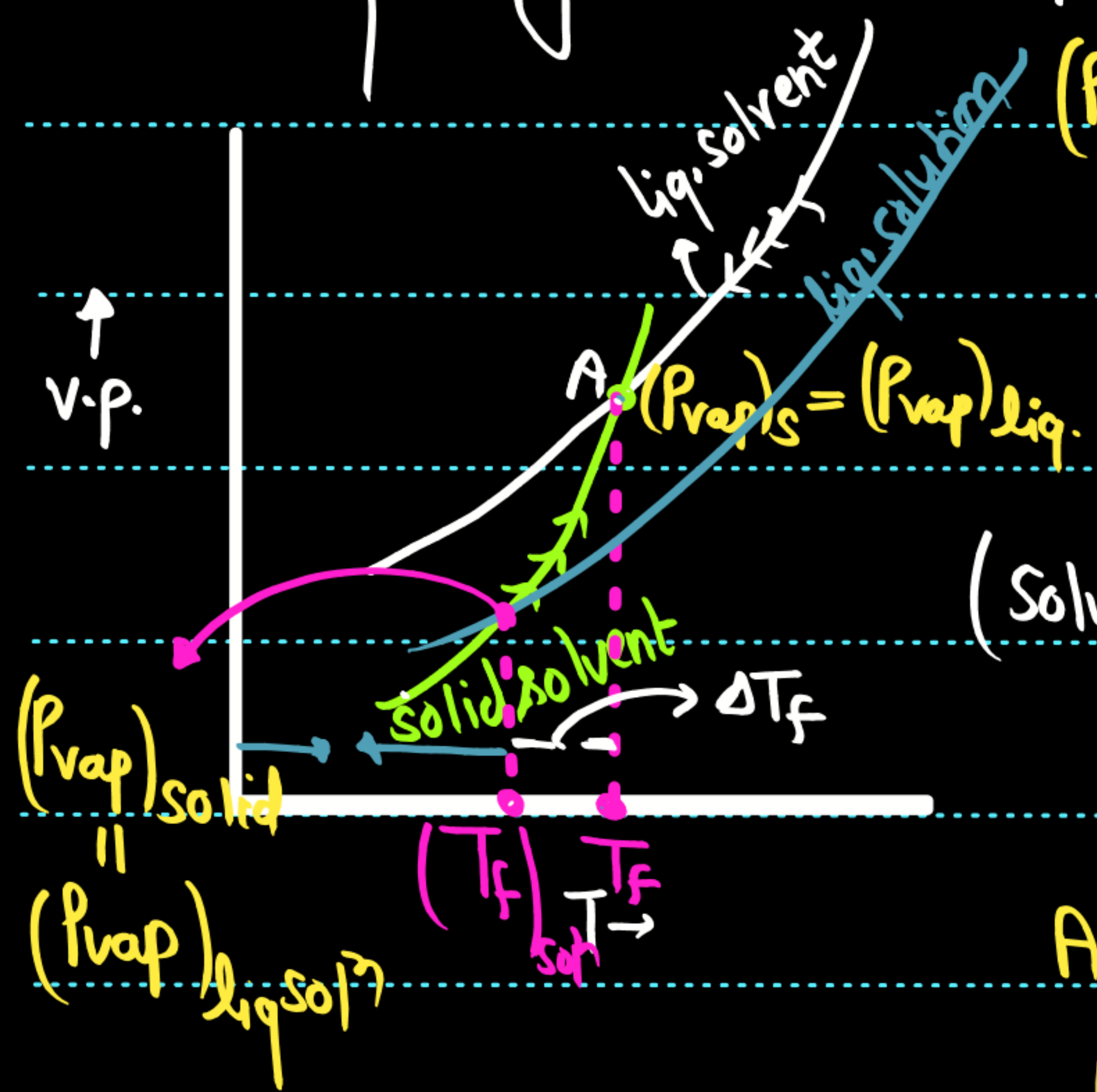
K_b = Const → same hai to ✓

$\Delta T_b \propto m$

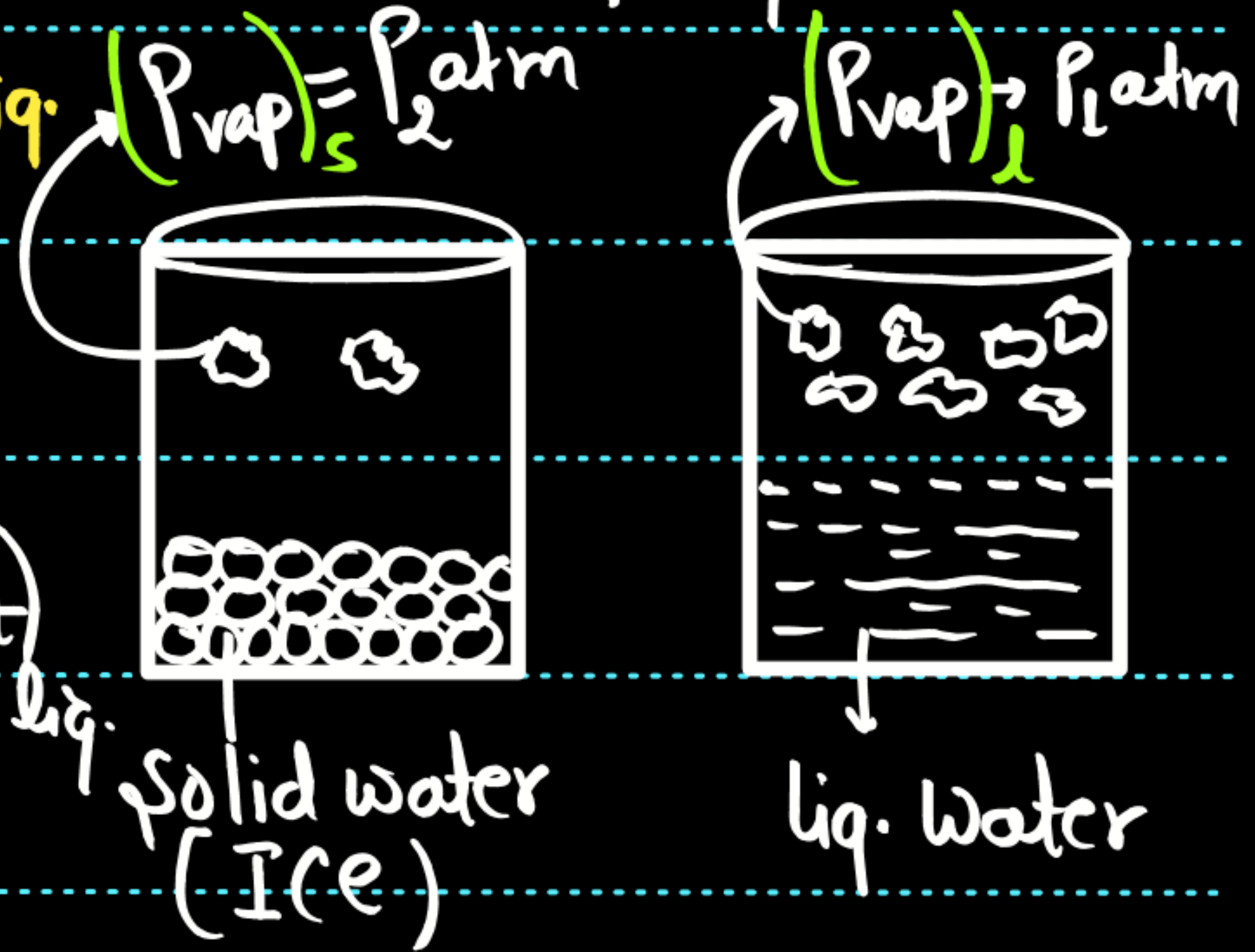
$\frac{?}{3}$

Freezing Point of pure liquid

$(P_{vap})_{solid} = (P_{vap})_{liq.} \Rightarrow$ T K $\Rightarrow$ F.P. of liquid



$(\text{Solvent})_{solid} \rightleftharpoons (\text{Solvent})_{liq.}$



At that temp., the v.p. of liquid phase is equal to the v.p. of its solid phase

Freezing of binary solution

Solute = NON volatile nature

Solvent = volatile nature

$\Delta T_f = (T_f)_{solvent} - (T_f)_{solution}$

$\Delta T_f \propto m$ (molality of sol^n)

→ $P_0 >> P_s$ - in presence of nonvolatile solute

$$(\text{Solvent})_{solid} \rightleftharpoons (\text{solvent})_{liq.\ solution}$$

In presence of nonvolatile solute, f.p. of solution decreases, which is known as **Depression of freezing point (ΔT_f)**

$\Delta T_f \propto m$

$$\Delta T_f = K_f m$$

where

ΔT_f = depression in f.p.

K_f = depression const for solvent (Croscopic Constant)

m = molality of soluhon

Q graph draw between v.p. Vs Temp., select Correct option

a) Max. f.p. = Sol^n-A

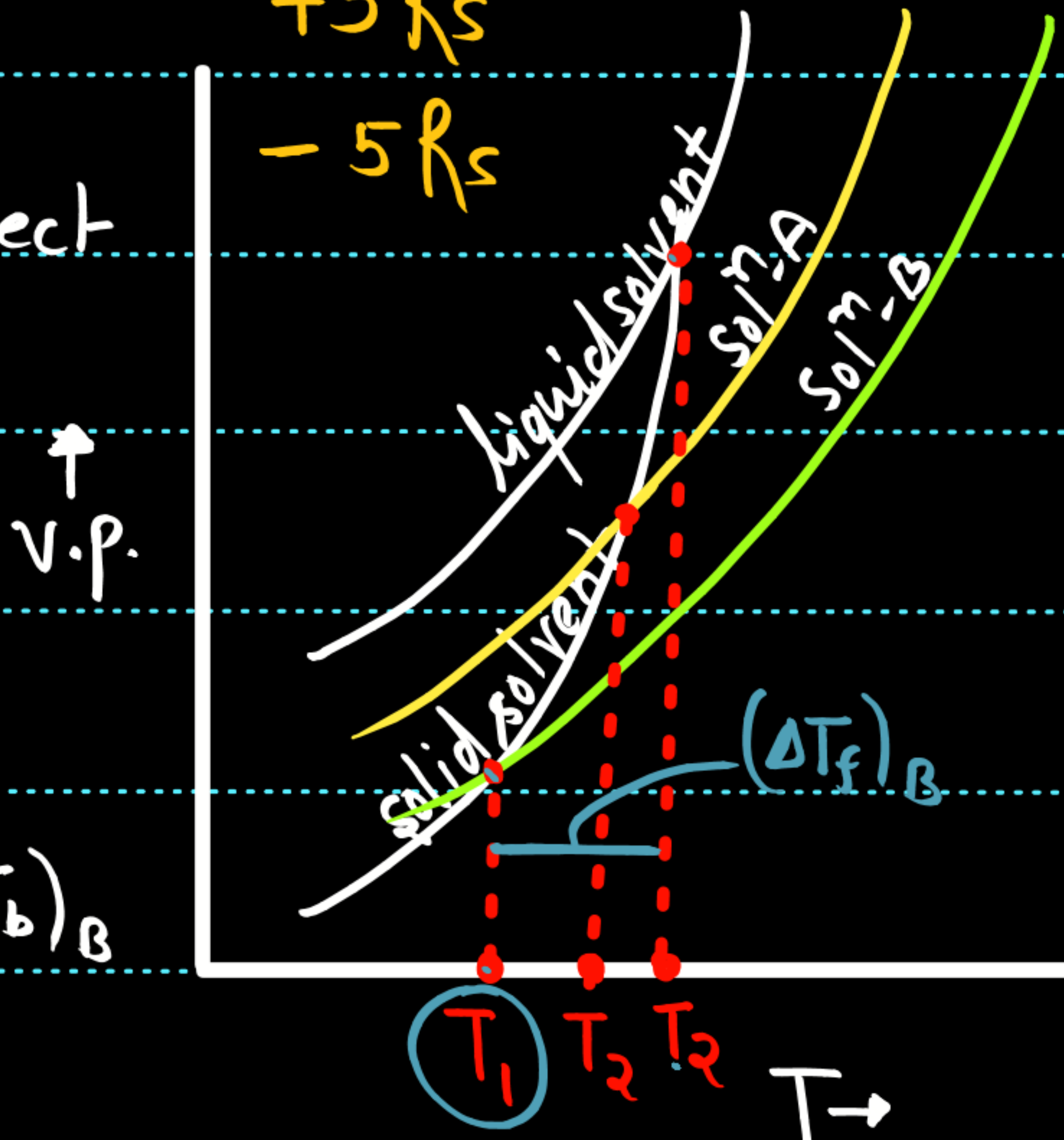
b) min f.p. = Sol^n-B

c) max depression in f.p. = $(\Delta T_b)_B$

d) b, c both Correct

+5Rs

−5Rs



CSD

$\Delta T_b = K_b m$

Where → ΔT_b = elevation of b.p.

$\uparrow \Delta T_b = \uparrow (T_b)_{soln} - (T_b)_{solv}$

→ $\Delta T_b \propto K_b$ (m = same ho)

→ $\Delta T_b \propto$ molality of soln

→ $\Delta T_b \propto n_{solute} / \text{mass of solvent}$

→ $(T_b)_{soln} \propto \Delta T_b$

→ $(T_b)_{soln} \propto K_b$, $(T_b)_{soln} \propto m$

$\Delta T_f = K_f m$

Where → ΔT_f = depression in f.P.

$\uparrow \Delta T_f = (T_f)_{solv} - (T_f)_{soln} \downarrow$

→ $\Delta T_f \propto K_f$ (m = same ho)

→ $\Delta T_f \propto$ molality of soln

→ $\Delta T_f \propto n_{solute} / \text{Mass of solvent}$

→ $(T_f)_{soln} \propto \frac{1}{\Delta T_f}$

→ $(T_f)_{soln} \propto \frac{1}{K_f}$, $(T_f)_{soln} \propto \frac{1}{m}$

CSD

$\Delta T_b = K_b m$

K_b = elevation Const or ebullo-scopic Const

→ K_b only depend upon nature of Solvent ($(Solvent)_{vap} \rightleftharpoons (Solvent)_{liq.\,sol^n}$)

→ $K_b = \frac{R T_b^2 \times M.wt\ of\ solvent}{1000 \times \Delta H_{vap}}$

T_b = b.p. of solvent

ΔH_{vap} = enthalpy of vapourisation

$\Delta T_f = K_f m$

K_f = depression Const. or Crayo-spoic Const.

→ K_f only depend upon nature of solvent ($(Solvent)_{liq\,sol^n} \rightleftharpoons (solvent)_{solid}$)

→ $K_f = \frac{R T_f^2 \times M.wt\ of\ solvent}{1000 \times \Delta H_f}$

T_f = f.p. of solvent

ΔH_f = enthalpy of freezing

Q a) 0.1m urea solⁿ

b) 0.2m glucose solⁿ

c) 0.01m sucrose solⁿ.

Q-1 → Arrange boiling point of solⁿ → $\Delta T_b = K_b m$ → $\Delta T_b \propto m$

$\Delta T_b \propto (T_b)_{soln}$ → c < a < b

Q-2 Arrange freezing point of solⁿ. → $\Delta T_f = K_f m$ → $\Delta T_f \propto m$

$\Delta T_f \propto \frac{1}{(T_f)_{soln}}$ → ΔT_f ⇒ c < a < b

$(T_f)_{soln}$ → b < a < c

Q 10 gram nonvolatile solute-X dissolve in 1000 gram of water, the boiling of water increases 1.5 K If K_b of water is 0.52 K m^{-1}, Calculate m.wt of solute-X

a) 32.5

b) 58.5

H.W.

c) 56

d) NONE


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CHEMISTRY
Liqiud solution
Lecture-07
Vedantu
MASTER TEACHER
Sarvesh Sir

Today’s Goal -

Freezing point
Osmotic pressure

Qsd-1

Sol^n-A → 6 gram Urea in 1 litre water $\frac{6}{60} = 0.1$

Sol^n-B → 18 gram glucose in 1 litre water $\frac{18}{180} = 0.1$

Sol^n-C 34.2 gram sucrose in 1 litre water $\frac{34.2}{342} = 0.1$

Arrange increasing order of boiling point of solution

a) A < B < C

b) A = B = C ✓

c) C < B < A

d) B < A < C

$\Delta T_b = K_b m$

$m = \frac{n_{solute}}{\text{Mass of sol}^n (kg)}$

$\Delta T_b \propto m$

$\Delta T_b = (T_b)_{sol^n} - (T_b)_{solvent}$

$(T_b)_{sol^n} \propto m$

Qsd-2 Select incorrect relation

?/2

a) $\Delta T_b = (T_b)_{soln} - (T_b)_{solvent}$

✓ b) $\Delta T_b = K_b \times \frac{W_{solute}}{M.wt \times \text{Mass of solvent (gram)}} \times 1000$

c) Value of K_b only depend upon nature of solvent

d) NONE

Osmosis →

S.P.M = only solvent molecule pas through S.P.M

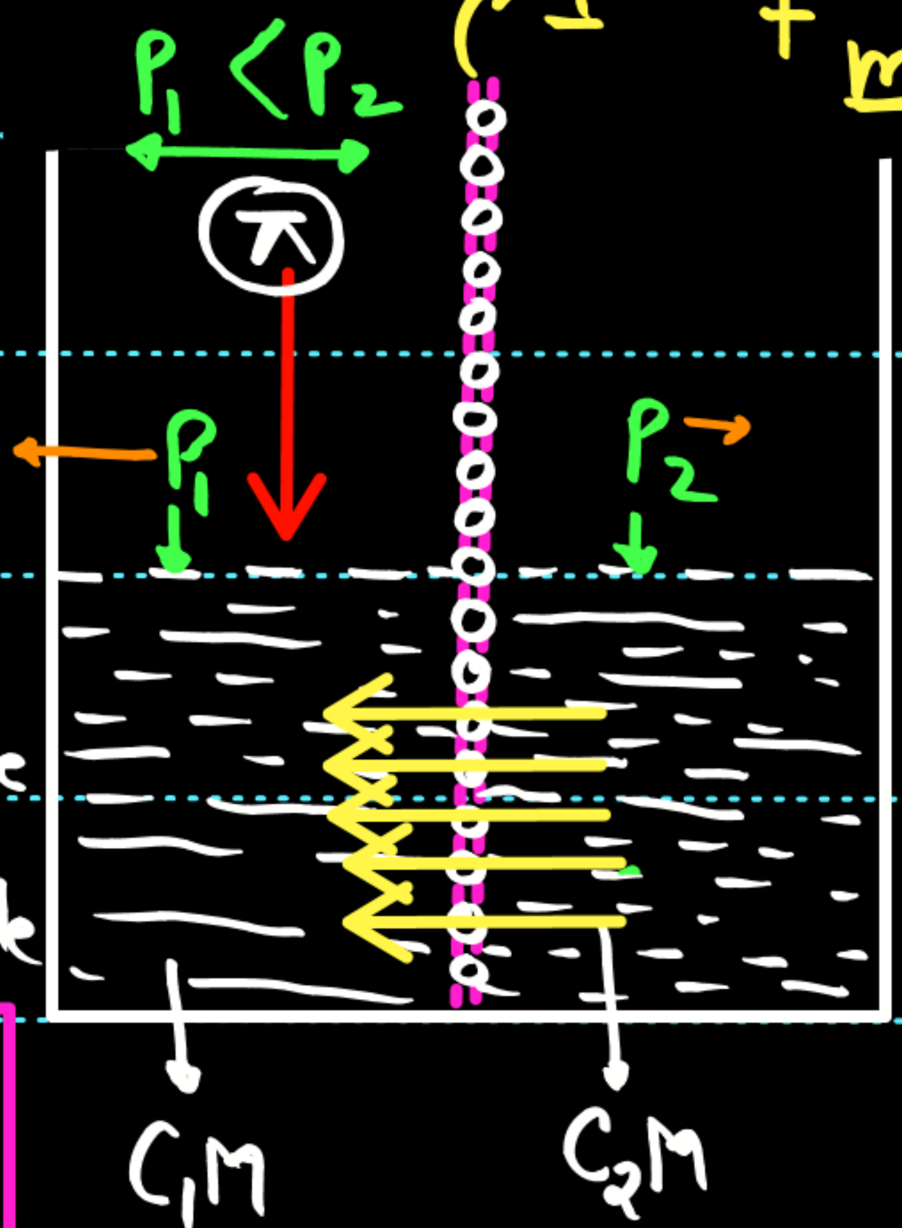
solute → migrate nahi honge

Why = ? **Reason** → size of solute molecule >>> size of solvent molecule

> **Note** → solute molecule of solⁿ-1 does not react with solute of solⁿ-2,

(S.P.M.)

Semipermeable membrane



$P_{vap} \propto \frac{1}{con}$

$C_1M > C_2M$

$P_1 < P_2$

Spontaneous migration of solvent molecule only low Con. of solution (C_2) to high Con. of solution (C_1M) through S.P.M.

or

Spontaneous migration of solvent molecule only high vapour pressure solⁿ. to low vapour pressure solⁿ. through S.P.M.

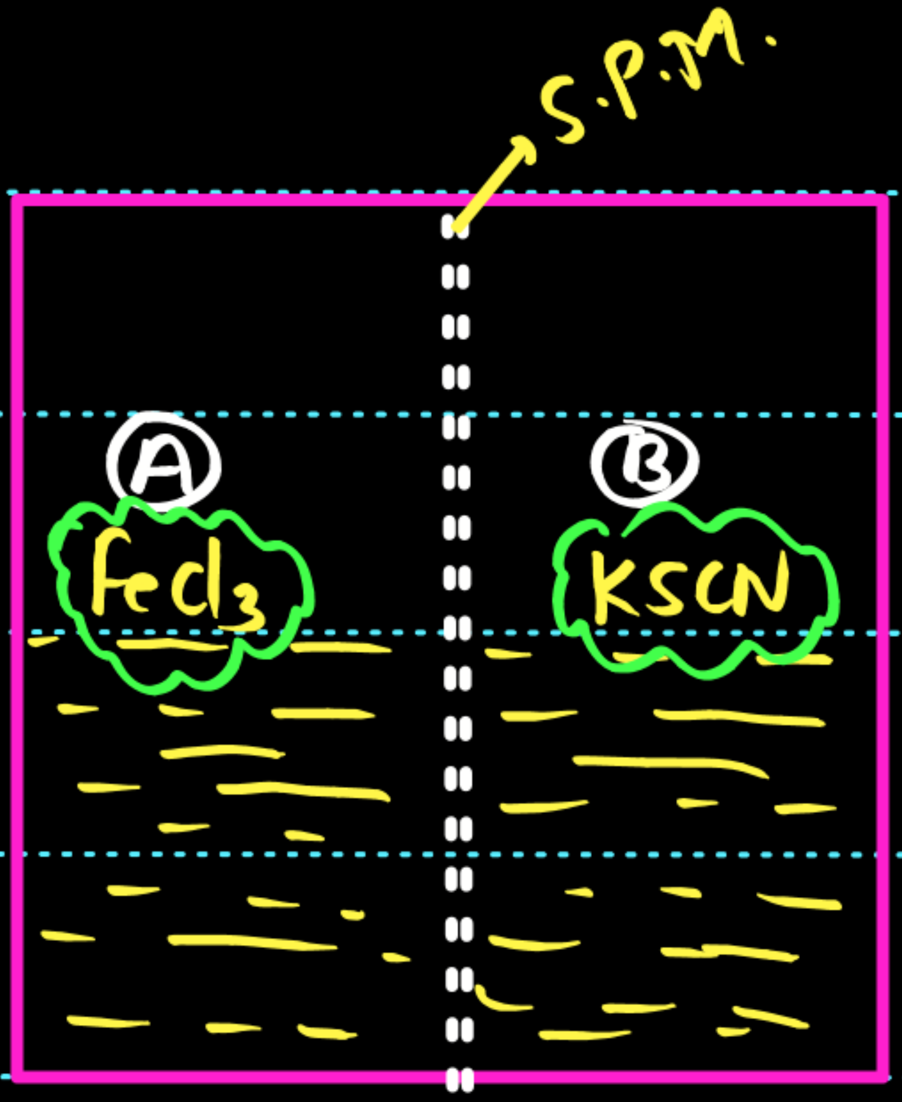
At Equilibrium → Con. of solⁿ-1 ≃ Con. of solⁿ-2

low Con. solⁿ − w ≃ high Con. of solⁿ + w

Q→ $FeCl_3$ and KSCN React

$$FeCl_3 + KSCN \longrightarrow Fe(SCN)_3 + KCl$$

↓ Blood Red Colour



Blood red col^r. form.

a) in Compartment - A

b) in Compartment - B

c) middle of A & B

~~d)~~ Blood red Col^r does not form

Q 2 mole solute in 300 gram water of sol^n-1 separate with S.P.M of 2 mole solute in 200 gram water of sol^n-2, After some time equalibrium stablised b/w them. Calculate what amount of water migrate in sol^n-1 to sol^n-2

a) 50 gram

b) 30 gram

c) 33.34 gram

d) NONE

at Eq. Con. of sol^n-1 = Con. of sol^n-2

$$\frac{2}{300-w} = \frac{2}{200+w}$$

$$200+w = 300-w$$

$$2w = 100, \; w = 50 \text{ gram}$$

CSP Osmosis → spontaneous migration of solvent molecule only through S.P.M.

1) low Con. of solⁿ → high Con. of solⁿ

or

high vap. pressure of solⁿ → Low vap. pressure of solⁿ

or

2) Only solvent Molecule → migrate

solute → migrate nahi krte →

** Reason → size of solute > size of solvent

*** Solute of solⁿ-1 does not react with solute of solⁿ-2

3) At Equilibrium

Con. of solⁿ-1 ⇌ Con. of solⁿ-2

$$\frac{n_{solute}}{(Mass)_{solv} + w} = \frac{n_{solute}}{(Mass)_{solv} - w}$$

Csp Osmotic pressure → External pressure → $\pi + P_1 = P_2$ → stop Osmosis

→ $\pi = P_2 - P_1$

→ $\pi = CRT = \frac{n_{solute}}{\text{Vol. of sol}^n} \times R \times T$

→ $\pi \propto n_{solute}$ (R, T, Vol of sol^n - same)

→ Isotonic solution → $\pi_1 = \pi_2$

→ $C_1 = C_2$

→ $\pi_1 > \pi_2$

π_1 ↓ Hypertonic sol^n ; π_2 ↓ Hypotonic sol^n

→ Reverse Osmosis → $P_{ext} > \pi$

= Osmosis opposite direction me hone lagti hai

Osmotic pressure → $P_1 < P_2$

$$\pi + P_1 = P_2$$

Osmotic pressure → total external pressure exerted by Low vapour pressure or high Con. of sol^n site to stop osmosis.

$$\pi = P_2 - P_1$$

$$\pi = CRT$$

where → C = Con. of solution
T = temp. of sol^n
R = gas Const

Reverse Osmosis

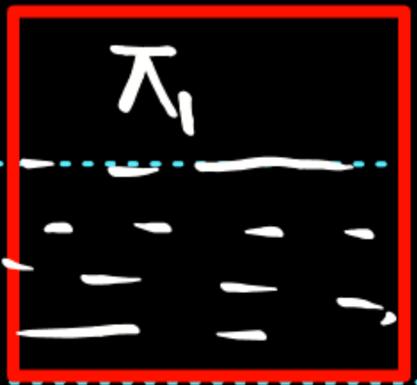
→ $P_1 < P_2$ → Osmosis → low Con or high v.p
↓
high Con. or low v.p.

→ $\pi + P_1 = P_2$ → Osmosis stop ho gai

$(P + \pi) + P_1 > P_2$ → Osmosis occurs opposite direction
or Reverse Osmosis

External pressure $> \pi$

Isotonic, Hypertonic & Hypotonic solution





$\pi_1 = \pi_2$ → isotonic solution

$C_1RT_1 = C_2RT_2$

$C_1 = C_2$

Suppose

$\pi_1 > \pi_2$

π_1 → Hypertonic solution

π_2 → Hypotonic solution

Colligative properties → those physical properties which is only depend upon Number of mole of solute

not → nature of solute & size of solute particle

1.) Relative lowering of v.p $\left(\frac{P_0 - P_s}{P_s} = \frac{n_A}{n_A + n_B} \right)$

2) Elevation of B.P. → $\Delta T_b = K_b m$

3) depression of f.p. → $\Delta T_f = K_f m$

4) Osmotic pressure → $\pi = CRT$

Q51. Which one is a colligative property? [CBSE AIPMT 1994]

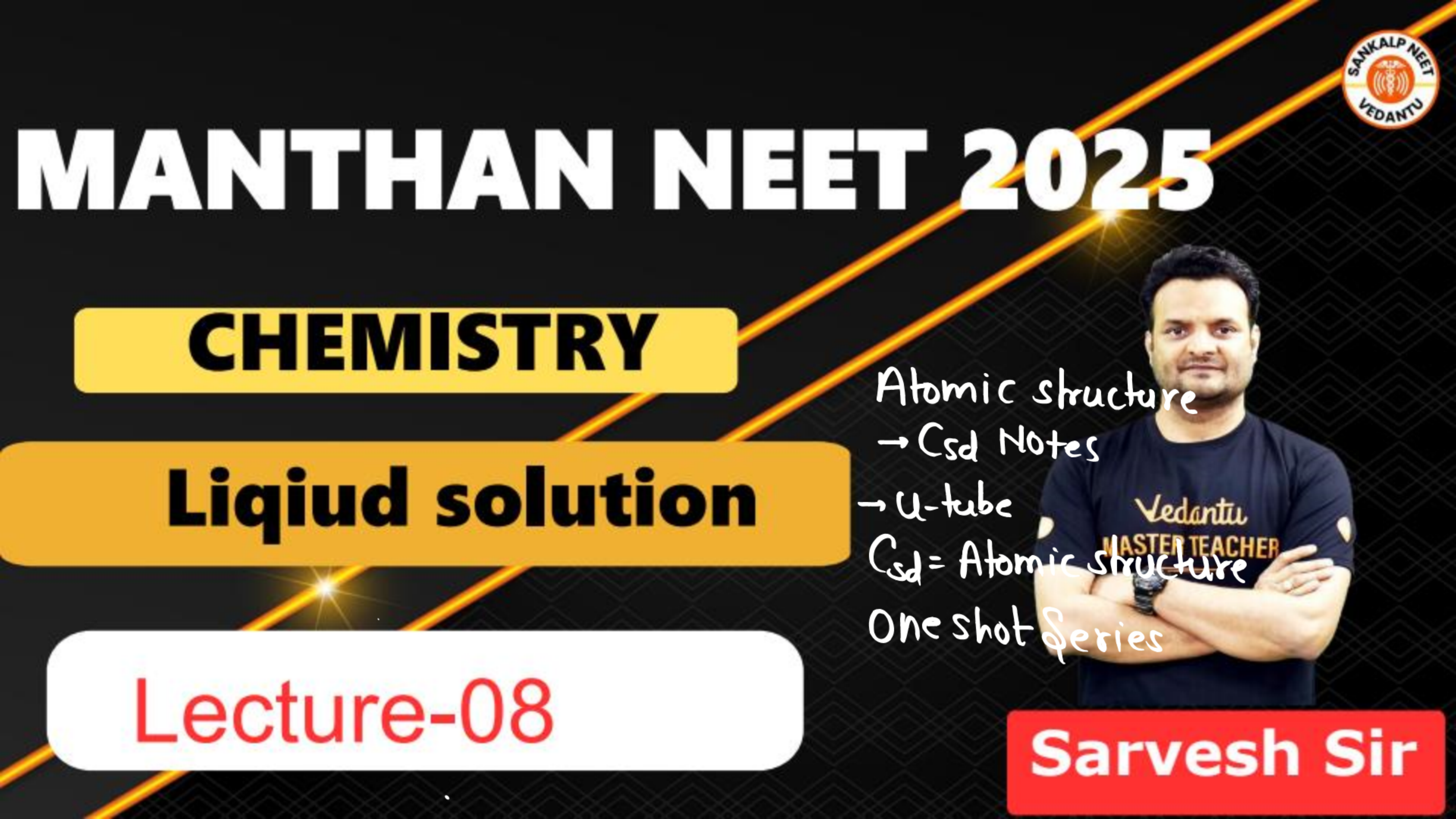
(a) Boiling point ✗

(b) Vapour pressure ✗

(c) Osmotic pressure ✓✓

(d) Freezing point ✗


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CHEMISTRY
Liqiud solution
Lecture-08
Atomic structure
→ Csd Notes
→ U-tube
Csd = Atomic structure
One shot Series
Vedantu
MASTER TEACHER
Sarvesh Sir

Today's Goal -

Colligative properties

Qsd=1 Select Correct statements for Osmosis process

a) Osmosis → solvent molecules move Low Con. to high Con. solⁿ

b) Osmosis → solvent molecules move high Con. to Low Con. solⁿ

c) Osmosis → solvent molecules move high v.p to low v.p. solⁿ

d) a, c are Correct

13:3

Qsd-2 In Colligative properties

$\frac{?}{2}$

a) depend upon size of solute particles

✓ b) only depend upon No. of solute particle

c) only depend upon Con. of solution.

d) depend upon nature and size of solute particles

Colligative properties

(1) R.L.V.P. → $\frac{P_0 - P_s}{P_0} = X_A = \frac{n_A}{n_A + n_B}$

2) Elevation of B.P. → $\Delta T_b = K_b m$

3) depression of F.P. → $\Delta T_f = K_f m$

4) Osmotic pressure → $\pi = CRT$

Abnormal Colligative properties

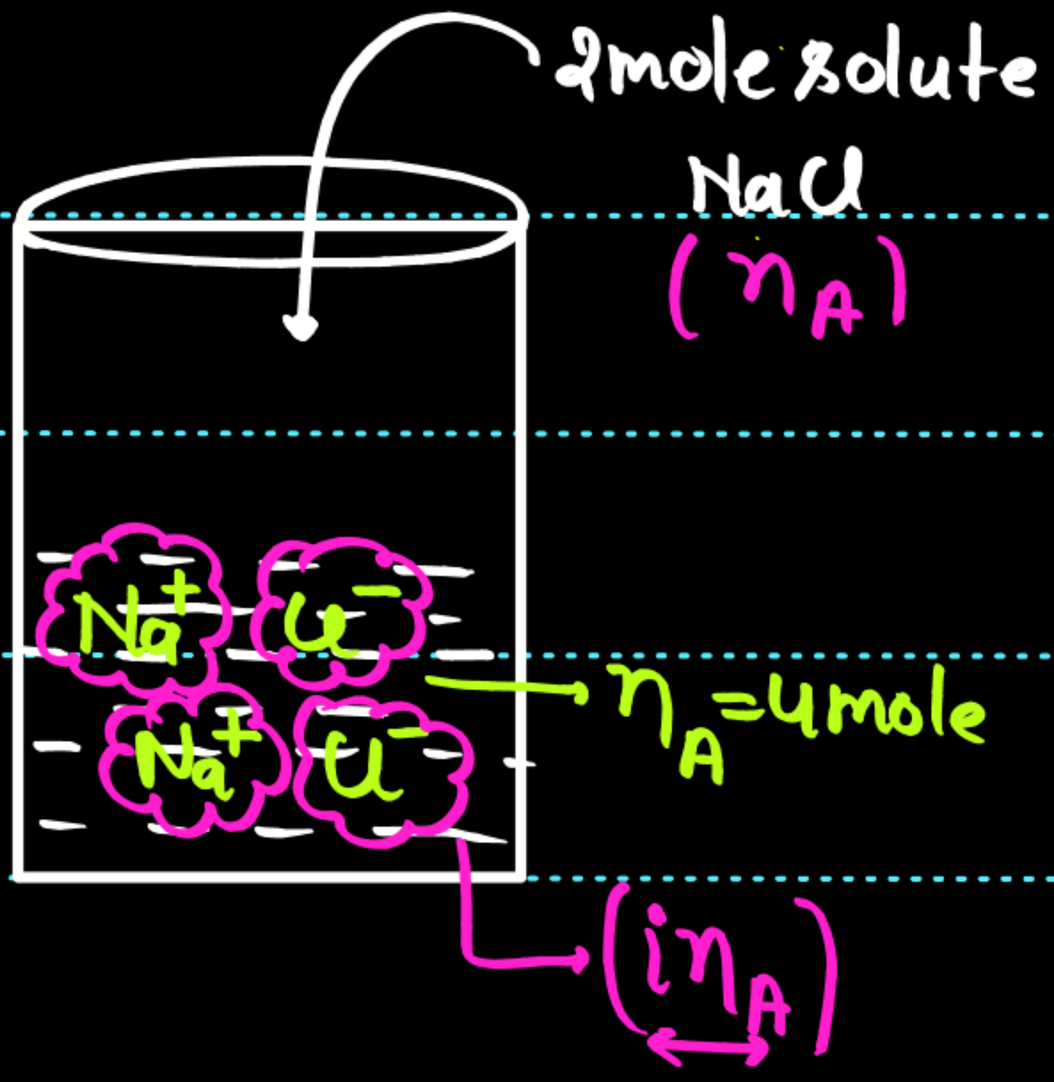
$n_A = 2$ mole

→ 3-possibility

1) Solute particle = No dissociation or No Asso-ciation

2) Solute particle = dissociation

3) Solute particle ciation



i = Vant's haff factor

1) R.L.V.P. → $\frac{P_0 - P_s}{P_0} = X_A = \frac{n_A}{n_A + n_B} \Rightarrow \boxed{\frac{P_0 - P_s}{P_0} = \frac{i n_A}{i n_A + n_B}}$

$$\boxed{\frac{P_0 - P_s}{P_0} = i X_A} \rightarrow \text{wrong} = \frac{i n_A}{n_A + n_B}$$

2) $\Delta T_b = K_b m = K_b \times \frac{n_A}{(\text{Mass})_{\text{solv}}(\text{kg})} \Rightarrow \Delta T_b = K_b \times \frac{i n_A}{(\text{Mass})_{\text{solv}}(\text{kg})} \Rightarrow \boxed{\Delta T_b = i K_b m}$

3) $\Delta T_f = K_f m \Rightarrow \Delta T_f = K_f \cdot \times \frac{i n_A}{(\text{Mass})_{\text{solv}}(\text{kg})} \Rightarrow \boxed{\Delta T_f = i K_f m}$

4) $\pi = CRT = \frac{n_A}{(Vol)_{soln}} RT \Rightarrow \pi = \frac{i n_A}{(Vol.)_{soln}} RT$

$$\boxed{\pi = iCRT}$$

Where → i = Vant's haff factor

$$i = \frac{\text{total No. of solute particles After dissociation or Association}}{\text{total No. of solute particles before dissociation or Association}}$$

$$i = \frac{\text{Experimental value of colligative properties}}{\text{theoretical value of Colligative properties}}$$

Case-1 → NO Association or NO dissociation

$i = 1$ → Hydrocarbon → C_6H_6, $C_6H_5CH_3$, Urea

→ Carbohydrate → glucose, sucrose

Case-2 → Dissociation

$$A \longrightarrow nB$$

1	0	t=0
$1-\alpha$	$n\alpha$	in sol^n

total solute particle $= 1-\alpha+n\alpha$

$= 1+(n-1)\alpha$

$$i = \frac{1+(n-1)\alpha}{1}$$

$$\boxed{i = 1+(n-1)\alpha}$$

Where → α = degree of dissociation

η = No. of mole of solute particles form by 1 mole of solute

Case = 3 → Association

ηA	→	B	
1		0	$t=0$
$1-\alpha$		$\frac{\alpha}{\eta}$	in sol^n

$$i = \frac{1-\alpha+\frac{\alpha}{\eta}}{1} = \frac{1+\left(\frac{1}{\eta}-1\right)\alpha}{1}$$

$$\boxed{i = 1+\left(\frac{1}{\eta}-1\right)\alpha}$$

$i<1$

CSD → Colligative properties

1) $\frac{P_o - P_s}{P_o} = \frac{i n_A}{i n_A + n_B}$

2) $\Delta T_b = i K_b m$

3) $\Delta T_f = i K_f m$

4) $\pi = i CRT$

5) Case-1 = No Association or No Dissociation ⇒ $i = 1$

→ Hydrocarbon, Carbohydrate

→ Urea, glucose, sucrose etc.

→ 6 → Case = 2 ⇒ Dissociation

$i = 1 + (n-1)\alpha$ ⇒ $i > 1$

α = degree of dissociation, n = total no of solute particles form by 1 mole of solute

→ Acid, Base, Salt → in water solvent

$\alpha = 1 \Rightarrow i = n$

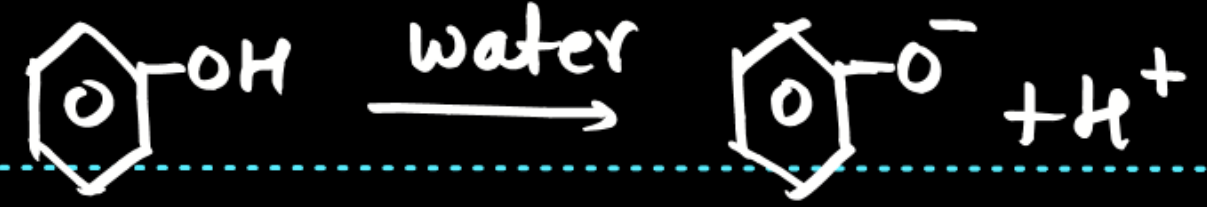
Case-3 = Association

$i = 1 + \left(\frac{1}{n} - 1\right)\alpha$

$i < 1$ $\rightarrow \alpha = 1 \Rightarrow i = \frac{1}{n}$

$2CH_3COOH \underset{}{\overset{Benzene}{\rightleftharpoons}} (CH_3COOH)_2$

Phenol



Note → Carboxylic acid → in polar solvent (H_2O)

$RCOOH \rightleftharpoons R\text{-}COO^- + H^+$

Carboxylic acid → nonpolar solvent (C_6H_6)

$2RCOOH \rightleftharpoons (RCOOH)_2$

$Hg_2Cl_2 \rightleftharpoons Hg_2^{+2} + 2Cl^-$



Note → $K_2HgI_4 \rightarrow K_2[HgI_4]$

$\rightarrow 2K^+ + [HgI_4]^{-2}$

$Cu_2I_2 \rightarrow Cu_2^{+2} + 2I^-$

Q → Calculate Vant's haff factor, suppose 100% dissociation or Association

a) $Al_2(SO_4)_3 \longrightarrow 2Al^{+3} + 3SO_4^{-2} \Rightarrow i = 5$

b) CH_3COOH in water → $CH_3COOH \longrightarrow CH_3COO^- + H^+ \rightarrow i = n = 2$

c) CH_3COOH in Benzene solvent ⇒ $2CH_3COOH \rightleftharpoons (CH_3COOH)_2 \rightarrow i = \frac{1}{n} = \frac{1}{2}$

d) Urea → $i = 1$

e) $Na_2SO_4 \rightarrow 2Na^+ + SO_4^{-2} \Rightarrow n = 3 \Rightarrow i = 3$

f) $K_2HgI_4 \rightarrow 2K^+ + [HgI_4]^{-2} \rightarrow i = 3$

Q → K_2HgI_4 dissociate 20% in water solvent than calculate Vant's half factor

$\alpha = \frac{20}{100} = 0.2$

a) 0.8

b) 3.0

c) 2.4

d) 1.4

$K_2HgI_4 \longrightarrow 2K^+ + [HgI_4]^{-2}$

$n = 3$

$i = 1 + (n-1)\alpha$

$i = 1 + (3-1) \times 0.2$

$= 1 + 2 \times 0.2 = 1 + 0.4 = \underline{1.4}$

Q9. The boiling point of 0.2 mol kg^{-1} solution of X in water is greater than equimolal solution of Y in water. Which one of the following statements is true in this case? [CBSE AIPMT 2015]

(a) X is undergoing dissociation in water

(b) Molecular mass of X is greater than molecular mass of Y

(c) Molecular mass of X is less than the molecular mass of Y

(d) Y is undergoing dissociation in water while X undergoes no change

$y = x = m \Rightarrow (T_b)_x > (T_b)_y$

$\Delta T_b = i K_b m$

$\Delta T_b \propto i$

$(T_b)_{soln} \propto i \Rightarrow i_x > i_y$

Q12. Of the following 0.10 m aqueous solutions, which one will exhibit the largest freezing point depression? **[CBSE AIPMT 2014]**

(a) KCl → $i = n = 2$

(b) $C_6H_{12}O_6$ → $i = 1$

(c) $Al_2(SO_4)_3$ → $i = n = 5$

(d) K_2SO_4 → $i = n = 3$

$\Delta T_f = i K_f m$

(K_f: same; m: same)

$\Delta T_f \propto i$

Q14. The freezing point depression constant for water is $-1.86^{\circ}C\ m^{-1}$. If 5.00 g Na_2SO_4 is dissolved in 45.0 g H_2O, the freezing point is changed by $-3.82^{\circ}C$. Calculate the van't Hoff factor for Na_2SO_4

[CBSE AIPMT 2011]

(a) 2.63

(b) 3.11

(c) 0.381

(d) 2.05

K_f

ΔT_f

$$\Delta T_f = i K_f m$$

$$3.82 = i \times 1.86 \times \frac{(5/142)}{45 \times 10^{-3}}$$

$$\frac{3.82}{1.86} \times \frac{45}{5} \times 10^{-3} \times 142 = i$$

$$i = 2.624$$

Na_2SO_4

→ 46
→ 32
→ 64
142

Q53. Which of the following aqueous solutions has minimum freezing point? **[CBSE AIPMT 1991]**

(a) 0.01 m NaCl

(b) 0.005 m MgI_2

(c) 0.005 m C_2H_5OH → i=1

(d) 0.005 m $MgSO_4$

$\Delta T_f = i K_f m$

→ $\Delta T_f \propto i m$

$(T_f)_{soln} \propto \frac{1}{(\Delta T_f)}$

$\uparrow \Delta T_f = (T_f)_{solv} - (T_f)_{soln}$

$(T_f)_{solv}$ ↓ Const, $(T_f)_{soln}$ ↓

a) $0.01 \times 2 = 0.02$

b) $0.005 \times 3 = 0.015$

c) $0.005 \times 1 = 0.005$

d) $0.005 \times 2 = 0.010$

Q15. The van't Hoff factor, i for a compound which undergoes dissociation in one solvent and association in other solvent is respectively **[CBSE AIPMT 2011]**

(a) less than one and less than one

(b) greater than one and less than one

(c) greater than one and greater than one

(d) less than one and greater than one

Q43. Which of the following 0.10M aqueous solution will have the lowest freezing point? [CBSE AIPMT 1997]

(a) $Al_2(SO_4)_3$

(b) $C_5H_{10}O_5$

(c) KI

(d) $C_{12}H_{22}O_{11}$ H.W

Q48. Which one of the following salts will have the same value of van't Hoff factor (i) as that of $K_4[Fe(CN)_6]$? [CBSE AIPMT 1994]

(a) $Al_2(SO_4)_3$

(b) NaCl

(c) $Al(NO_3)_3$

(d) Na_2SO_4

H.W

Q50. At 25ºC the highest osmotic pressure is exhibited by 0.1 M solution of

[CBSE AIPMT 1994]

(a) $CaCl_2$

(b) KCl

(c) Glucose

(d) Urea H.W.


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MANTHAN NEET 2025

CHEMISTRY

Liquid solution

Lecture-09



Sarvesh Sir

Today's Goal -

Colligative properties

Qsd-1

Q48. Which one of the following salts will have the same value of van't Hoff factor (i) as that of $K_4[Fe(CN)_6]$? **[CBSE AIPMT 1994]**

(a) $Al_2(SO_4)_3 \rightarrow n = 5$ ✓

(b) $NaCl \rightarrow n = 2$

(c) $Al(NO_3)_3 \rightarrow n = 4$

(d) $Na_2SO_4 \rightarrow n = 3$

$K_4[Fe(CN)_6] \longrightarrow 4K^+ + [Fe(CN)_6]^{-4}$

$n = 5$

$i = n = 5 \rightarrow \alpha = 100\%$ or 1

Qsd-2 If two solution is isotonic with each other

It means.

a) $(V.P.)_1 = (V.P.)_2$ ✗

b) $\pi_1 = \pi_2$ ✓✓

c) $C_1 = C_2$

d) All Correct

$\frac{?}{2}$

$\pi_1 = \pi_2$

$i_1 C_1 = i_2 C_2$

$i_1 = i_2 \rightarrow$ If

$C_1 = C_2$

Q17. A solution of sucrose (molar mass = 342 g mol^{-1}) has been prepared by dissolving 68.5g of sucrose in 1000 g of water. The freezing point of the solution obtained will be **[CBSE AIPMT 2010]**

(Given: k_f for water = 1.86 K kg mol^{-1})

(a) –0.372ºC

(b) –0.520ºC

(c) +0.372ºC

(d) –0.570ºC

Q19. A 0.0020 m aqueous solution of an ionic compound $Co(NH_3)_5(NO_2)Cl$ freezes at –0.00732ºC. Number of moles of ions which 1 mole of ionic compound produces on being dissolved in water will be (k_f = –1.86ºC/m) **[CBSE AIPMT 2009]**

(a) 2

(b) 3

(c) 4

(d) 1

$\Delta T_f = i K_f m$

$0.00732 = i \times 1.86 \times 0.002$

$732 \times 10^{-5} = i \times 372 \times 10^{-5}$

$i = \frac{732}{372} \approx 2$

744

$n = ? \rightarrow i = n$

$\Delta T_f = (T_f)_{solv} - (T_f)_{soln}$

$\Delta T_f = -(T_f)_{soln}$

① $[Co(NH_3)_5(NO_2)]Cl$

② $[Co(NH_3)_5Cl]NO_2$

Q20. 0.5 molal aqueous solution of a weak acid (H X) is 20% ionised. If k_f for water is 1.86 K kg mol^{-1}, the lowering in freezing point of the solution is **[CBSE AIPMT 2007]**

(a) –1.12 K

(b) 0.56 K

(c) 1.12 K

(d) –0.56 K

$HX \rightarrow H^+ + X^-$

$n = 2$

$\Delta T_f = i K_f m$

$= 1.2 \times 1.86 \times 0.5$

$= .60 \times 1.86$

$= 1.116$

$\Delta T_f = 1.12$

$(T_f)_{soln} = -1.12$

1 minute

Intext

Example

Exercise

Exemplar

$i = 1 + (n-1)\alpha$

$i = 1 + (2-1) \times 0.2$

$i = 1 + 0.2 = 1.2$

$\Delta T_f = (T_f)_{solv} - (T_f)_{soln}$

$(T_f)_{solv} > (T_f)_{soln}$

i=1 ion nahidega

Q24. 1.00 g of a non-electrolyte solute (molar mass 250 g mol^{-1}) was dissolved in 51.2g of benzene. If the freezing point depression constant, k_f of benzene is 5.12 K kg mol^{-1}, the freezing point of benzene will be lowered by

[CBSE AIPMT 2006]

K_f $\Delta T_f = ?$

(a) 0.4K

(b) 0.3K

(c) 0.5K

(d) 0.2K

$$\Delta T_f = i K_f m$$

$$= 1 \times 5.12 \times \frac{(1/250)}{51.2 \times 10^{-3}}$$

$$= \frac{512 \times 1000}{250 \times 512}$$

$$\Delta T_f = 2/5 = 0.4$$

Q28. A solution of urea (mol. Mass 56 g mol^{-1}) boils at 100.18ºC at the atmospheric pressure. If k_f and k_b for water are 1.86 and 0.512 kg mol^{-1} respectively, the above solution will freeze at

[CBSE AIPMT 2005]

(a) –6.54ºC

(b) 6.54ºC

(c) 0.654ºC

(d) –0.654ºC

$(T_f)_{solution}$

$\Delta T_f = -(T_f)_{solution}$

$\Delta T_f = i K_f m$

$\Delta T_f = 1 \times 1.86 \times m$

$\Delta T_f = 1 \times 1.86 \times \frac{0.18}{0.512}$

$\Delta T_f = 0.654$

$(T_f)_{soln} = -\Delta T_f = -0.654$

$\Delta T_b = i K_b m$

$0.18 = 1 \times 0.512 \times m$

$\Delta T_b = (T_b)_{soln} - (T_b)_{solv}$

$= 100.18 - 100$

$= 0.18°C$

Q36. Which of the following colligative property can provide molar mass of proteins (or polymers or colloids) with greatest precision?

[CBSE AIPMT 2000]

(a) Osmotic pressure

(b) Elevation in boiling point

(c) Depression in freezing point

(d) Relative lowering of vapour pressure

Q16. An aqueous solution is 1.00 molal in KI. Which change will cause the vapour pressure of the solution to increase? **[CBSE AIPMT 2010]**

✗ (a) Addition of NaCl

✗ (b) Addition of Na_2SO_4

✗ (c) Addition of 1.00 molal KI

✓ (d) Addition of water

$(m)_{KI} = 1m$

10Rs - -10Rs

1 minute = 60 sec

Water → solvent

$\downarrow Con = \frac{\text{mole of solute}}{\uparrow \text{Vol. of soln}}$

$\frac{P_0 - P_s}{P_0} = X_A$

$(P_0 - P_s) = X_A \times P_0$

↓ lowering of v.p.

$\downarrow P_s \propto \frac{1}{(Con.)}$

Q43. Which of the following 0.10M aqueous solution will have the lowest freezing point? **[CBSE AIPMT 1997]**

$i = n \rightarrow \alpha = 100\%$

(a) $Al_2(SO_4)_3 \rightarrow i = 5$

(b) $C_5H_{10}O_5 \rightarrow i = 1$

(c) $KI \rightarrow i = 2$

(d) $C_{12}H_{22}O_{11} \rightarrow i = 1$

$(T_f)_{soln} = -\Delta T_f$

$(T_f)_{soln} \propto \frac{1}{i}$

Q50. At 25ºC the highest osmotic pressure is exhibited by 0.1 M solution of

[CBSE AIPMT 1994]

(a) $CaCl_2$ → $i = 3$ (H.W.)

(b) KCl → $i = 2$

(c) Glucose → $i = 1$

(d) Urea → $i = 1$

$\pi = icRT$

$\pi \propto i$

ideal and non-ideal Solution

Binary solution

- **ideal solution**
- **Non-ideal solution**

ideal solution

→ follows Raoult's law

→ $P_T = P_A + P_B$

→ $P_A = P_A^0 X_A$

Non-ideal solution

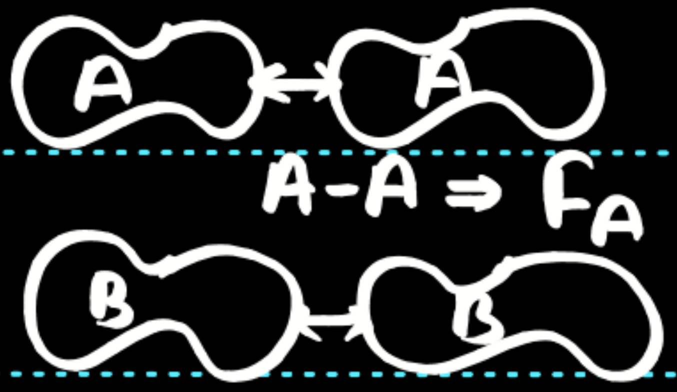
→ Not follows Raoult's law

→ $P_T \neq P_A + P_B$

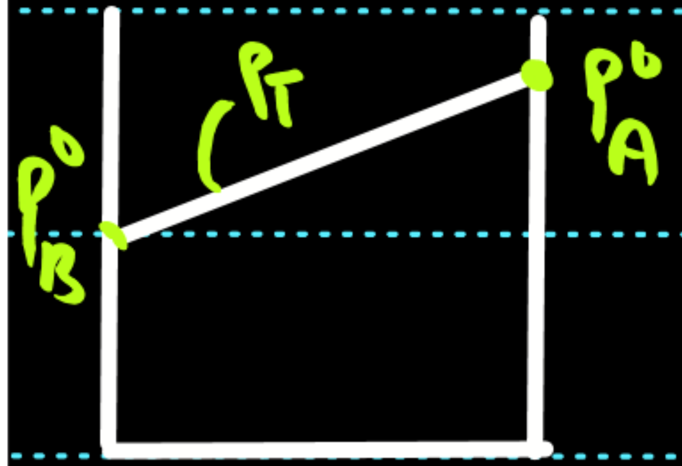
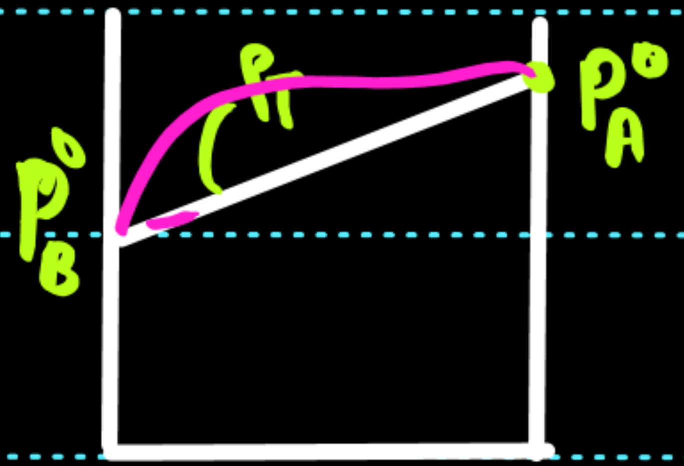
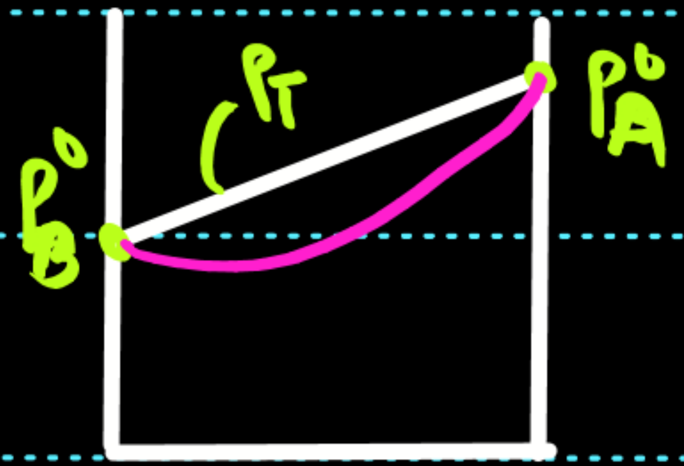
$P_A \neq P_A^0 X_A$

NON-ideal solution

Positive deviation	Negative deviation
→ $(P_T)_{Exp} > P_A^0 X_A + P_B^0 X_B$	→ $(P_T)_{Exp} < (P_A^0 X_A + P_B^0 X_B)_{R.L.}$
→ $P_A > P_A^0 X_A$	→ $P_A < P_A^0 X_A$
→ $P_B > P_B^0 X_B$	→ $P_B < P_B^0 X_B$

Properties	ideal solution	Positive deviation	Negative deviation
1) Attraction Force  $A-A \Rightarrow F_A$ $B-B \rightarrow F_B$	$F_A = F_B = F_{A-B}$ $A-A = B-B = A-B$ $V.P. \propto \frac{1}{force}$	$F_A \approx F_B > F_{A-B}$	$F_A \approx F_B < F_{A-B}$
2) Change in volume $V_1 \rightarrow$ Solute $V_2 \rightarrow$ Solvent V_{soln} = Solution $\Delta V =$	$\Delta V = V_{soln} - (V_1 + V_2)$ $\Delta V = 0$	$\Delta V = +ve$	$\Delta V = -ve$

Properties	ideal solution	Positive deviation	Negative deviation
3) Change in enthal-py (ΔH)	$\Delta H = 0$	$\Delta H = +ve$	$\Delta H = -ve$
$\Delta H = H_{soln} - H_{solute} + H_{solv}$ H_{soln}: $-ve$, H_{solute}: $+ve$, H_{solv}: $+ve$			
4) Entropy change $(\Delta S)_{soln}$	$(\Delta S)_{soln} = +ve$	$(\Delta S)_{soln} = +ve$	$(\Delta S)_{soln} = +ve$

Properties	ideal solution	Positive deviation	Negative deviation
5) Gibbs free energy change (ΔG)	$(\Delta G)_{soln} = -ve$	$(\Delta G)_{soln} = -ve$	$(\Delta G)_{soln} = -ve$
6) Vapour pressure of soln.	 $X_A = 0$, $X_B = 1$; $X_A = 1$, $X_B = 0$ $(P_T)_{Exp} = P_{R.L.}$	 $X_A = 0$, $X_B = 1$; $X_A = 1$, $X_B = 0$ $(P_T)_{Exp} > P_{R.L.}$	 $X_A = 0$, $X_B = 1$; $X_A = 1$, $X_B = 0$ $(P_T)_{Exp} < P_{R.L.}$



$P_{exp} \Rightarrow P_T$

↓

90mm

70mm

$P_A^0 x_A + P_B^0 x_B$

↓

80mm

$$(P_T)_{Exp.} = (P_A^0 x_A + P_B^0 x_B)_{R.L.}$$

$$(P_T)_{Exp} > (P_A^0 x_A + P_B^0 x_B)_{R.L.} \rightarrow \text{+ve deviation}$$

$$(P_T)_{Exp} < (P_A^0 x_A + P_B^0 x_B)_{R.L.} = \text{-ve deviat}^{n}$$

Q6. Which one of the following is incorrect for ideal solution?

[NEET 2016, PHASE-II]

(a) $\Delta H_{max} = 0$

(b) $\Delta U_{mix} = 0$

(c) $\Delta P = P_{obs} - P_{calculated\ by\ Raoult's\ law} = 0$

(d) $\Delta G_{mix} = 0$

Q30. Formation of a solution from two components can be considered as:

[CBSE AIPMT 2003]

I. Pure solvent → separated solvent molecules, ÄH$_{1}$

II. Pure solute → separated solute molecules, ÄH$_{2}$

III. Separated solvent and solute molecules → solution, ÄH$_{3}$

Solution so formed will be ideal, if

(a) ÄH$_{sol.}$ = ÄH$_{1}$ – ÄH$_{2}$ – ÄH$_{3}$

(b) ÄH$_{sol}$ = ÄH$_{3}$ – ÄH$_{1}$ – ÄH$_{2}$

(c) ÄH$_{sol}$ = ÄH$_{1}$ + ÄH$_{2}$ + ÄH$_{3}$

(d) ÄH$_{sol}$ = ÄH$_{1}$ + ÄH$_{2}$ – ÄH$_{3}$

Q11. Which one is not equal to zero for an ideal solution?

[CBSE AIPMT 2015]

(a) $\Delta H_{mix} = 0$

(b) $\Delta S_{mix} = +ve$

(c) $\Delta V_{mix} = 0$

(d) $\Delta P = P_{observed} - P_{Raoult} = 0$

$P_{Exp} = P_{R.L.}$

$\Delta P = P_{Exp} - P_{R.L} = 0$

Q→ v.p. of soln of liq-A and liq-B is 400mm Hg.
but v.p. of same soln calculated by Raoult's law found that 380 mm of Hg, Select Correct statements

a) Solution is ideal

b) Solution is show +ve deviation ✓

c) Solution is show –ve deviation

d) All incorrect

$P_{Exp} = 400mm$

$P_{R.L.} = 380$

$P_{Exp} > P_{R.L.}$


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SANKALP NEET VEDANTU

CHEMISTRY

Liquid solution

Lecture-10

U-tube → free

NYTS → syllabus

28July → test-①

→ Atomic structure

→ mole Concept



Sarvesh Sir

Today’s Goal -

HENRY’S LAW

Qsd-1 Condition of ideal solution

a) × $\Delta P = P_{Exp} - P_{R.L} = +ve$

b) × $\Delta H = +ve$

✓ c) ✓ $\Delta S = +ve$

d) × $\Delta G = +ve$

$f_A = f_B = f_{AB}$

$P_T = P_A + P_B$

$\Delta P = P_T - (P_A + P_B)_{R.L} = 0$

$\Delta H = 0$, $\Delta V = 0$

$\Delta S = +ve$

$\Delta G = -ve$

Qsd-2 → Select Condition of negative deviation solⁿ.

a) $\Delta S = +ve$ ✓

b) $\Delta H = -ve$ ✓

c) $\Delta G = -ve$ ✓

✓ d) All

$$\frac{?}{2}$$

Q23. A solution of acetone in ethanol [CBSE AIPMT 2006]

(a) shows a negative deviation form Raoult's law

(b) shows a positive deviation from Raoult's law

(c) behaves like a near ideal solution

(d) obeys Raoult's law

H.W.

Q55. All form ideal solution except [CBSE AIPMT 1998]

(a) C_6H_6 and $C_6H_5CH_3$

(b) C_2H_5Cl and C_2H_5I

(c) C_6H_5Cl and C_6H_5Br

(d) C_2H_5I and C_2H_5OH

H.W

Q56. An ideal solution is formed when its compounds [CBSE AIPMT 1998]

(a) have no volume change on mixing

(b) have no enthalpy change on mixing

(c) have both the above characteristics

(d) have high solubility

H.W.

Q56. An ideal solution is formed when its compounds [CBSE AIPMT 1998]

(a) have no volume change on mixing

(b) have no enthalpy change on mixing

(c) have both the above characteristics

(d) have high solubility

H.W.

Q → $H_2O + HNO_3$ sol^n is example of

(a) ideal sol^n

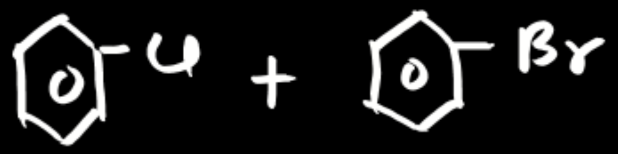
(b) Negative deviation //

(c) positive deviation

(d) NONE of these.

Q → select non ideal solution in given example

(a) $C_6H_6 + C_6H_5CH_3$

(b) 

(c) $CHCl_3 + CHBr_3$

ideal (a), (b), (c)

~~(d)~~ $H_2O + CCl_4$

ideal and non-ideal Solution

Binary solution

ideal solution

- → follows Raoult's law
- → $P_T = P_A + P_B$
- → $P_A = P_A^0 X_A$

Non-ideal solution

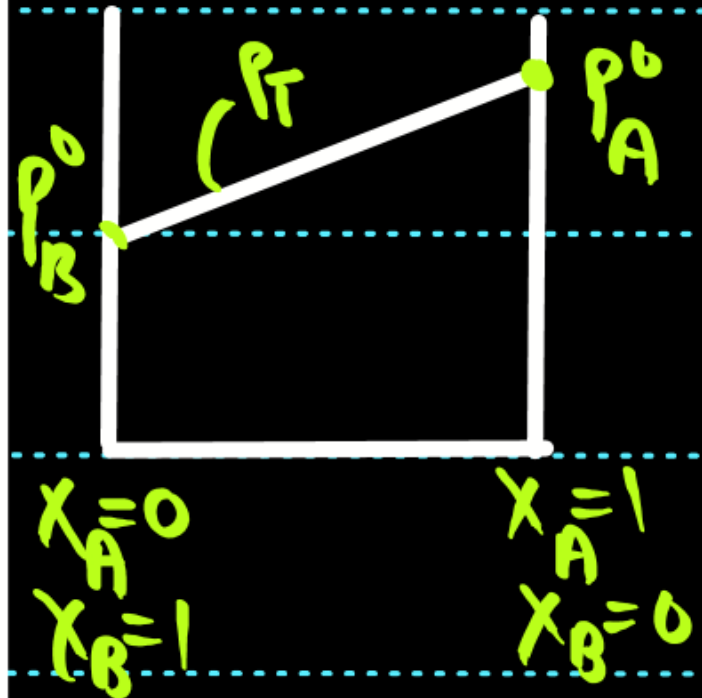
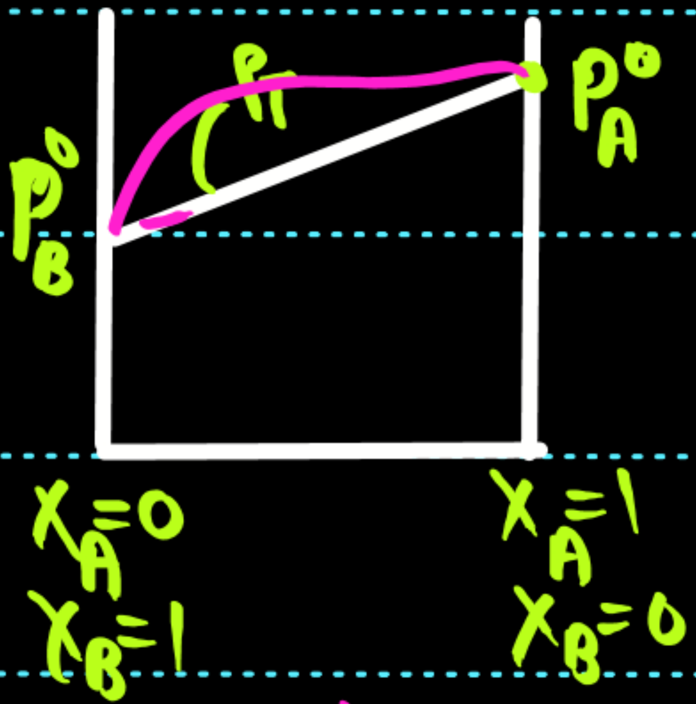
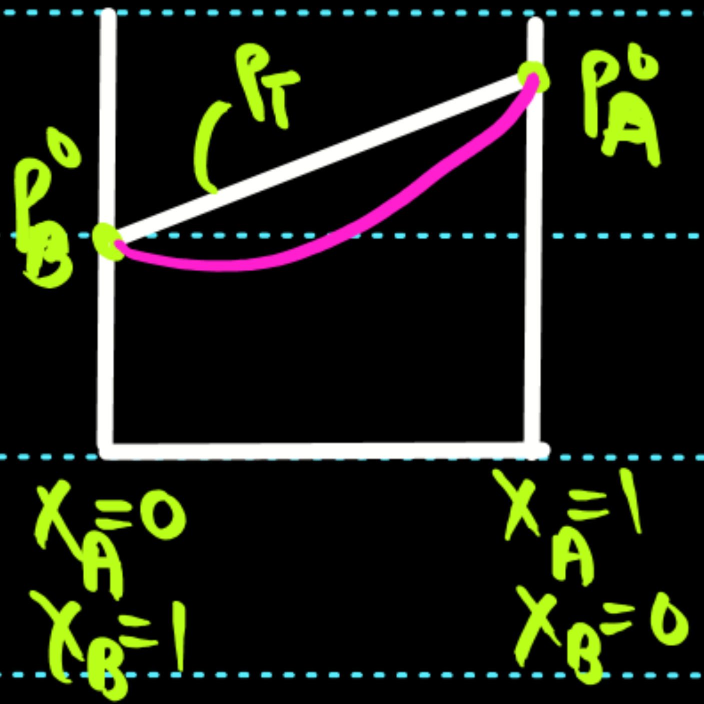
- → Not follows Raoult's law
- → $P_T \neq P_A + P_B$
- $P_A \neq P_A^0 X_A$

NON-ideal solution

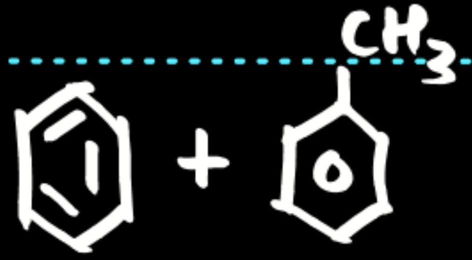
Positive deviation	Negative deviation
→ $(P_T)_{Exp} > P_A^0 X_A + P_B^0 X_B$	→ $(P_T)_{Exp} < (P_A^0 X_A + P_B^0 X_B)_{R.L.}$
→ $P_A > P_A^0 X_A$	→ $P_A < P_A^0 X_A$
→ $P_B > P_B^0 X_B$	→ $P_B < P_B^0 X_B$

Properties	ideal solution	Positive deviation	Negative deviation
1) **Attraction Force**  $A-A \Rightarrow F_A$  $B-B \rightarrow F_B$	$F_A = F_B = F_{A-B}$ $A-A = B-B = A-B$ $V.P. \propto \frac{1}{Force}$	$F_A \approx F_B > F_{A-B}$	$F_A \approx F_B < F_{A-B}$
2) **Change in volume** $V_1 \rightarrow$ Solute $V_2 \rightarrow$ Solvent V_{soln} = Solution $\Delta V =$	$\Delta V = V_{soln} - (V_1 + V_2)$ $\Delta V = 0$	$\Delta V = +ve$	$\Delta V = -ve$

Properties	ideal solution	Positive deviation	Negative deviation
3) Change in enthal-py (ΔH)	$\Delta H = 0$	$\Delta H = +ve$	$\Delta H = -ve$
$\Delta H = H_{soln} - H_{solute} + H_{solv}$ H_{soln}: $-ve$, H_{solute}: $+ve$, H_{solv}: $+ve$			
4) Entropy change $(\Delta S)_{soln}$	$(\Delta S)_{soln} = +ve$	$(\Delta S)_{soln} = +ve$	$(\Delta S)_{soln} = +ve$

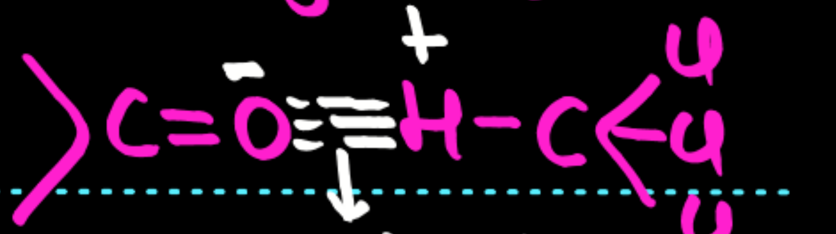
Properties	ideal solution	Positive deviation	Negative deviation
5) Gibbs free energy change (ΔG)	$(\Delta G)_{soln} = -ve$	$(\Delta G)_{soln} = -ve$	$(\Delta G)_{soln} = -ve$
6) Vapour pressure of soln.	 $(P_T)_{Exp} = P_{R.L.}$	 $(P_T)_{Exp} > P_{R.L.}$	 $(P_T)_{Exp} < P_{R.L.}$

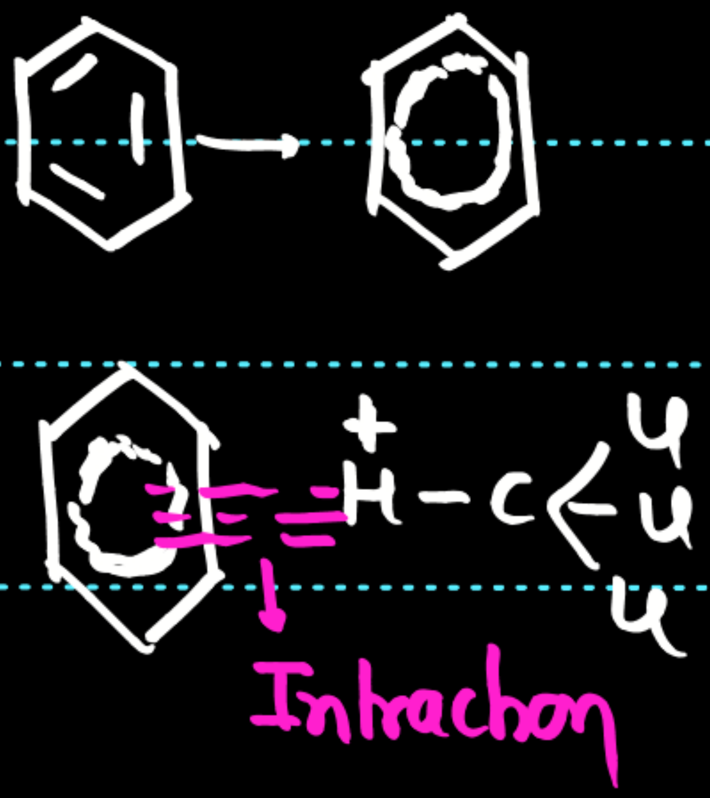
Properties	ideal solution	Positive deviation	Negative deviation
7) Csd →	$F_A = F_B = F_{AB}$	$F_A = F_B > F_{AB}$	$F_A = F_B < F_{AB}$
	solute aur sol-vent milne pr force approx same log raha hai	solute aur solvent Ko milne pr force Kam ho Raha hai	solute aur solvent Ko milne pr, force increase ho raha hai
	Ex → $C_6H_6 + C_7H_8$	Ex → $H_2O + CCl_4$	H_2O + Acid
	Ex $CCl_4 + CBr_4$	Ex → H_2O + nonpolar	H_2O + Base H_2O + salt

Properties	ideal solution	Positive deviation	Negative deviation
$(F, O, N)-H$	Ex 	H_2O + Molecule (not ionise in water)	$H_2O + HCl$ $H_2O + NaOH$
	Ex→ 	$H_2O + C_2H_5OH$	$H_2O + NaCl$ $H_2O + HNO_3$

Force order → Ion-Ion > H-bond > dipole-dipole > nonpolar-nonpolar

Note $CH_3COCH_3 + CHCl_3$

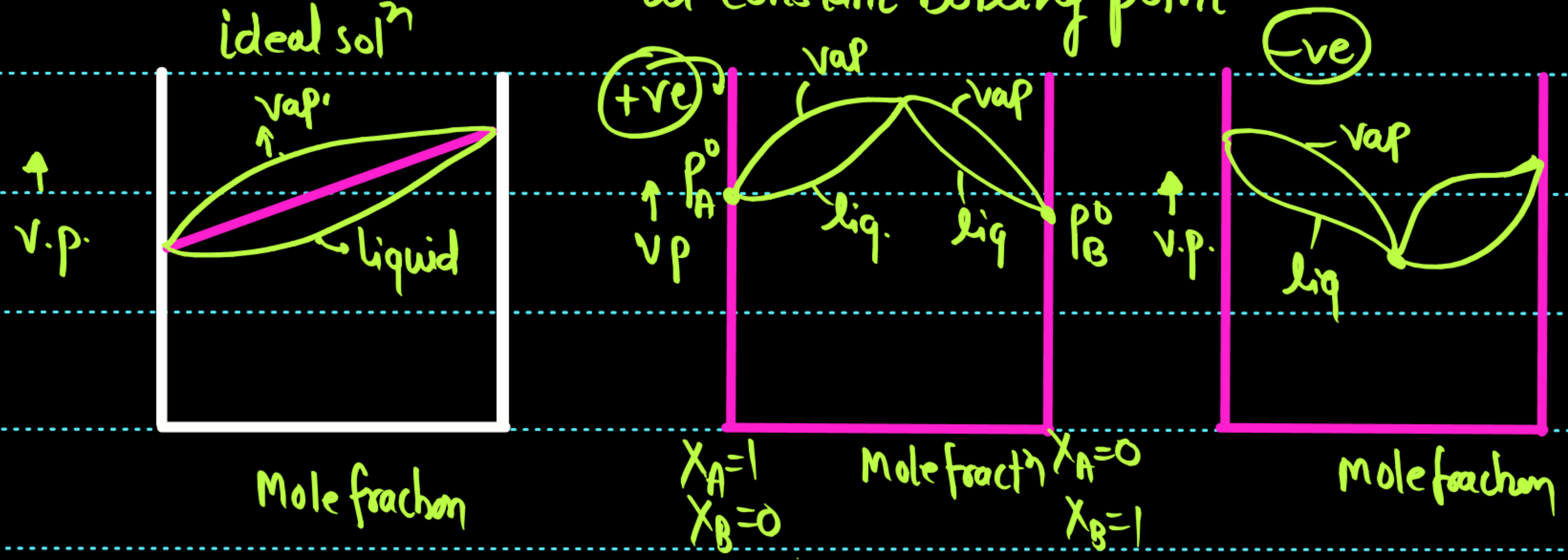


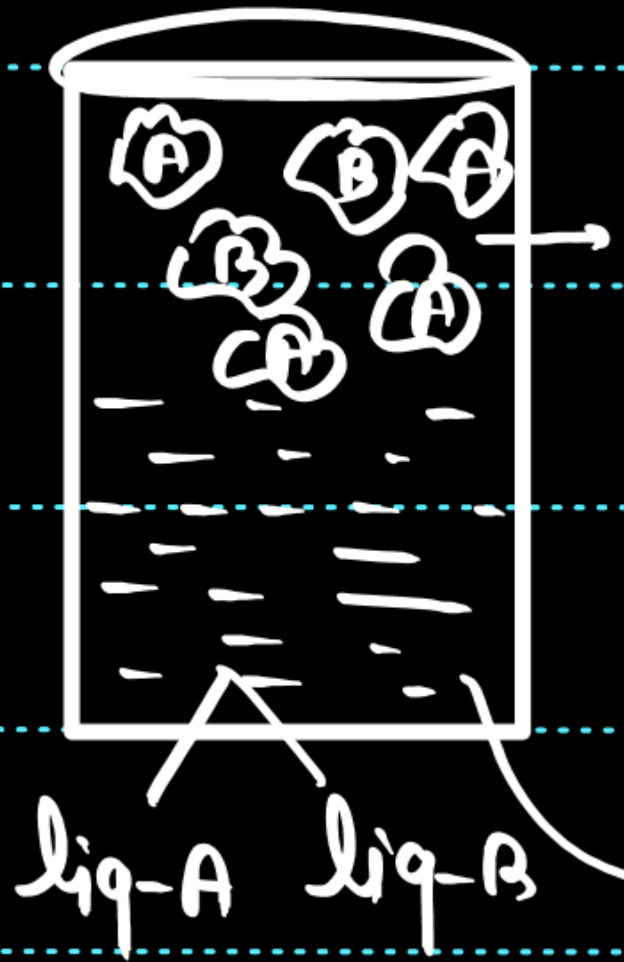
Properties	ideal solution	Positive deviation	Negative deviation
			Note $C_6H_6 + CHCl_3$ 

Properties	ideal solution	Positive deviation	Negative deviation
8) Azeotropic mixture	ideal solution seperated by fractional distillation method → nonazeotropic mixture	Those solution (non-ideal) which is not 100% seperated by fractional distillation method → Azeotropic mixture	
		Azeotropic Mixture	
		Minimum boiling Point azeotropic	Maximum boiling point Azeotropic mixture

Reason → Mole fraction of liquid phase = mole fraction of vapour phase

$X_A = Y_A$
$X_B = Y_B$ → all solution convert into vapour phase at constant boiling point





$P_{exp} \Rightarrow P_T$

↓

90mm

70mm

$\rightarrow P_A^0 x_A + P_B^0 x_B$

↓

80mm

$$(P_T)_{Exp.} = (P_A^0 x_A + P_B^0 x_B)_{R.L.}$$

$$(P_T)_{Exp} > (P_A^0 x_A + P_B^0 x_B)_{R.L.} \rightarrow \text{+ve deviation}$$

$$(P_T)_{Exp} < (P_A^0 x_A + P_B^0 x_B)_{R.L.} = \text{-ve deviat}^n$$

Q

a) $CH_3Br + CH_3Cl$ → ideal

b) $H_2O + CS_2$ → nonideal (+ve deviation)

c) $H_2O + HNO_3$ → nonideal (−ve deviation)

d) $H_2O + Na_2SO_4$ → nonideal (−ve deviation)

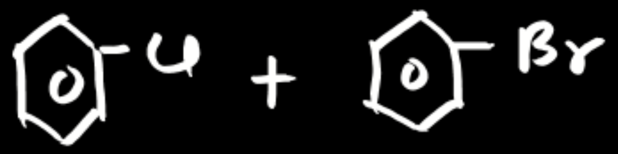
e) $H_2O + C_2H_5OH$ → nonideal (+ve deviation)

f) $CH_3OH + C_2H_5OH$ → ideal

Q → select Azeotropic mixture in given example

↳ nonideal solution

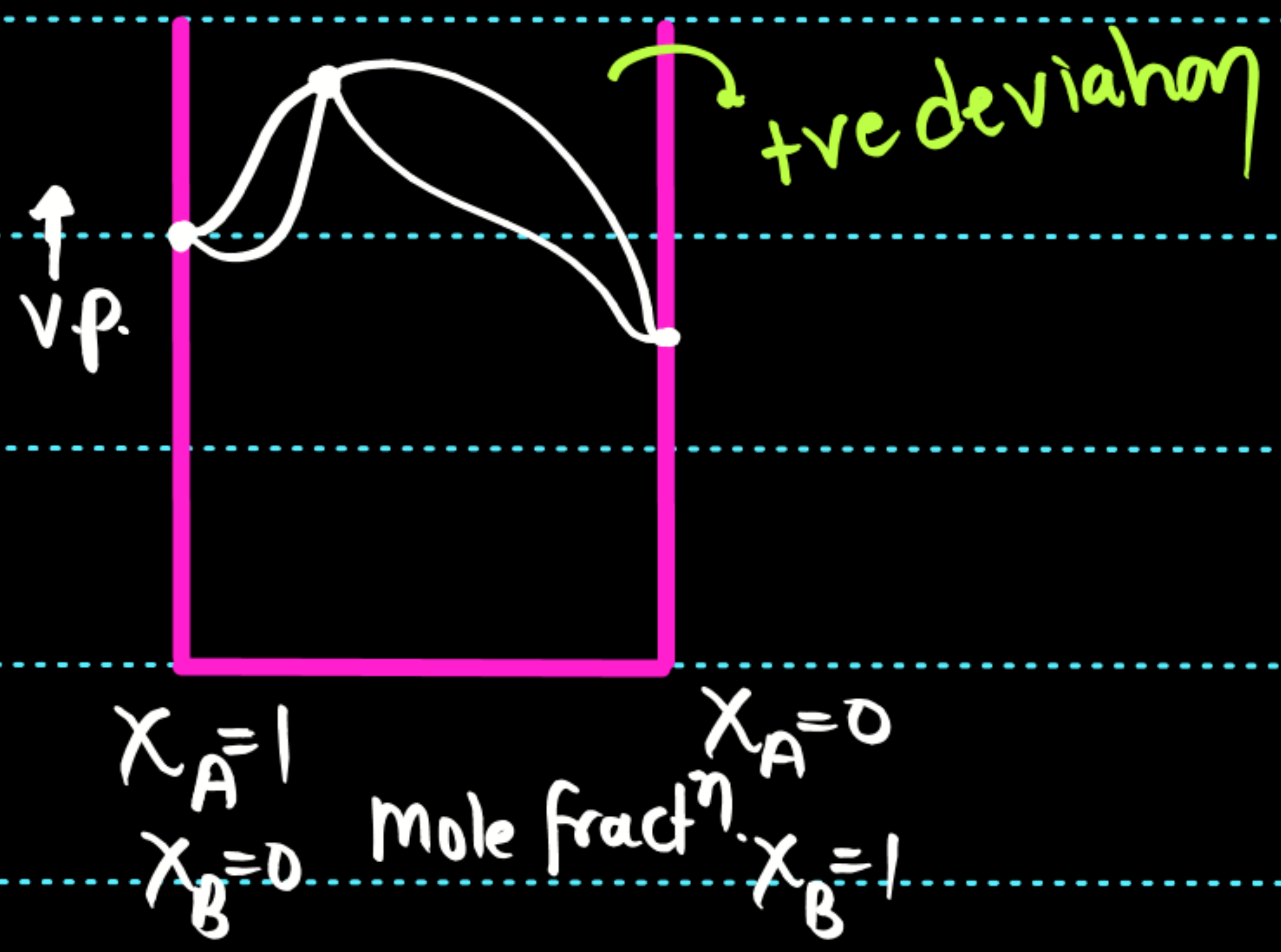
(a) $C_6H_6 + C_6H_5CH_3$

(b) 

(c) $CHCl_3 + CHBr_3$

(d) $H_2O + CCl_4$ ✓✓

Q above graph represent binary solution



a) $C_6H_6 + C_6H_5CH_3$ ✗

b) $H_2O + HCl$ — −ve deviation

c) ✓ $C_2H_5OH + H_2O$ — +ve deviation

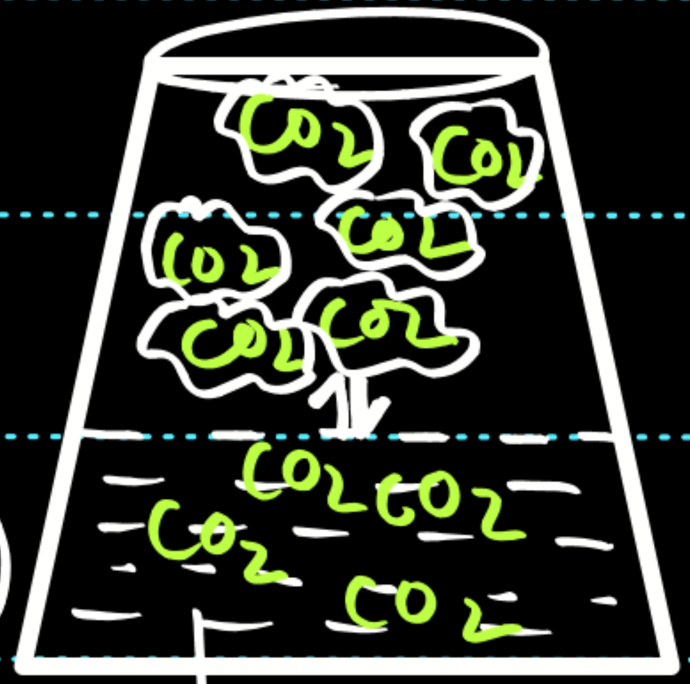
d) $CCl_4 + CBr_4$ ✗

Gas-Liquid Solution

Equilibrium

undissolve gas ⇌ dissolve gas

← $\Delta H = +ve$ → $\Delta H = -ve$ (exothermic)



gas-liq. solⁿ

Solubility ⇒ total amount of gas dissolve in $1cm^3$ = 1ml of saturated solution at const. temp. & pressure (Equilibrium)

Effecting factor in solubility of gas

1) Nature of gas and liquid

like dissolve like

polar gas + polar solvent = more solubility

nonpolar gas + nonpolar solvent = more solubility

balloon → nonpolar

water → polar

pitrol = nonpolar

Ex → solubility of CH_4 (→ nonpolar) in max.

a) H_2O ~~b)~~ Benzene solvent (nonpolar)

2) Effect of temperature → Equilibrium shifted in endothermic ($\Delta H = +ve$) site when temp. of Equilibrium system increases.

$$\text{Solubility} \propto \frac{1}{\text{temperature}}$$

3) Effect of pressure in solubility of gas (Henry's Law)

Equilibrium shifted less No. of mole of gas site, when pressure of Equilibrium system increase. ⇒ Equilb^m Shifted forward direction

Solubility ∝ Pressure of gas

Henry's Law → $P_g \propto X_g$ ⇒ total pressure of gas is directly perporational to mole fraction of gas in solution

$$P_g \propto X_g$$

$$\boxed{P_g = (K_H)_g X_g}$$

where → P_g = Pressure of gas

X_g = mole fraction of gas in solution

$$X_g = \frac{n_g}{n_g + n_{H_2O}}$$

$(K_H)_g$ = Henry's Constant → temperature → $\boxed{K_H \propto temp}$

→ nature of gas

$$X_g + X_{H_2O} = 1$$

$$P_g = (K_H)_g (1 - X_{H_2O})$$

$$P_g = (K_H)_g - (K_H)_g X_{H_2O}$$

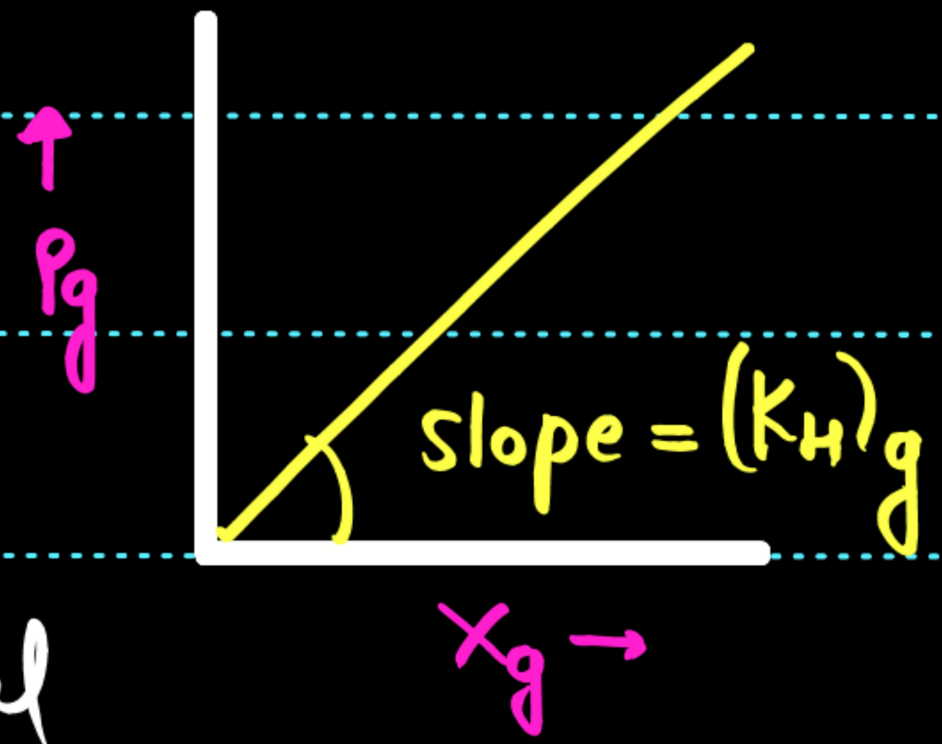
$$\boxed{P_g = -(K_H)_g X_{H_2O} + (K_H)_g}$$

Unit of $(K_H)_g$ = Atm or bar or torr or pascal

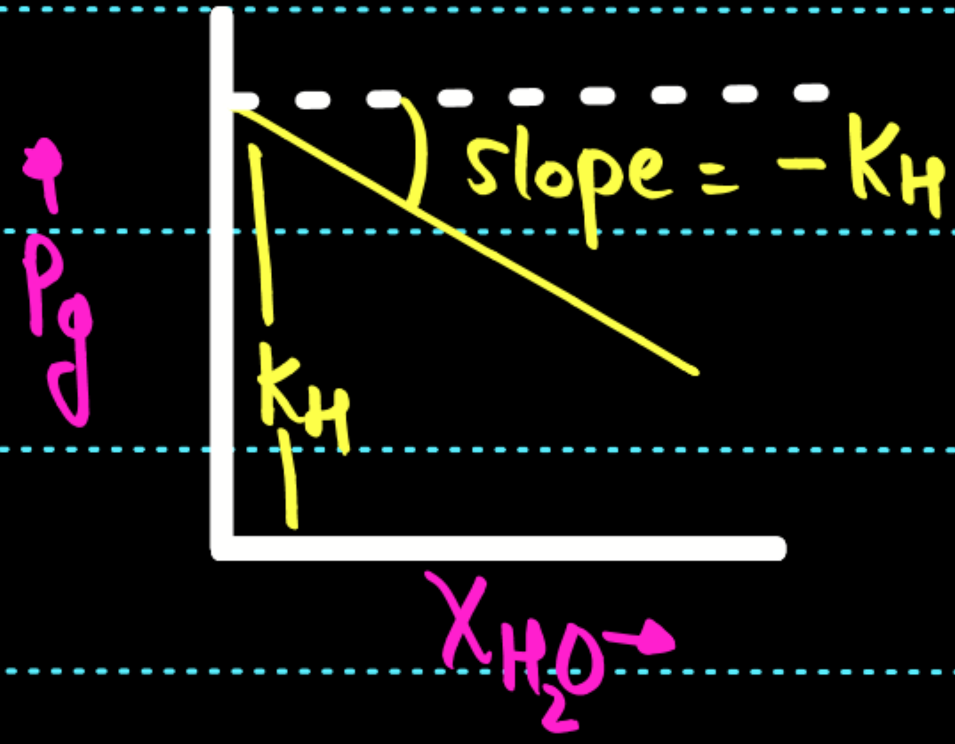
$$P_g = (K_H)_g X_g$$

$$(K_H)_g = \frac{P_g}{X_g} = \text{atm or bar or torr or pascal}$$

$$P_g = (K_H)_g X_g$$
$$y = m x$$



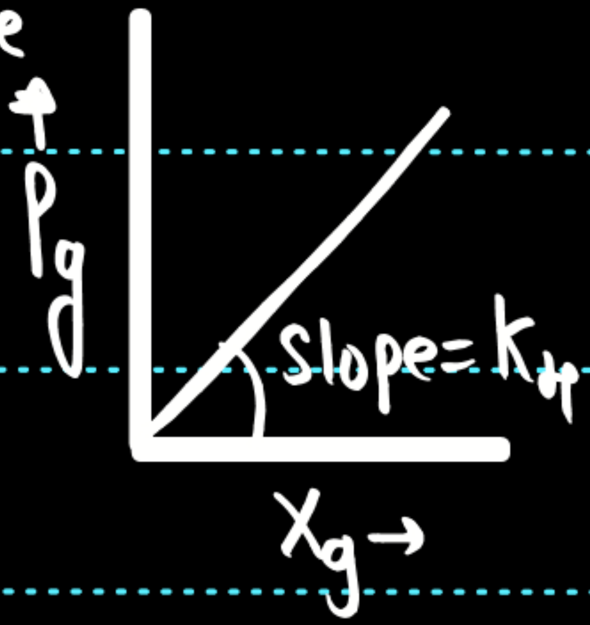
$$P_g = -K_H X_{H_2O} + K_H$$
$$y = -m x + c$$

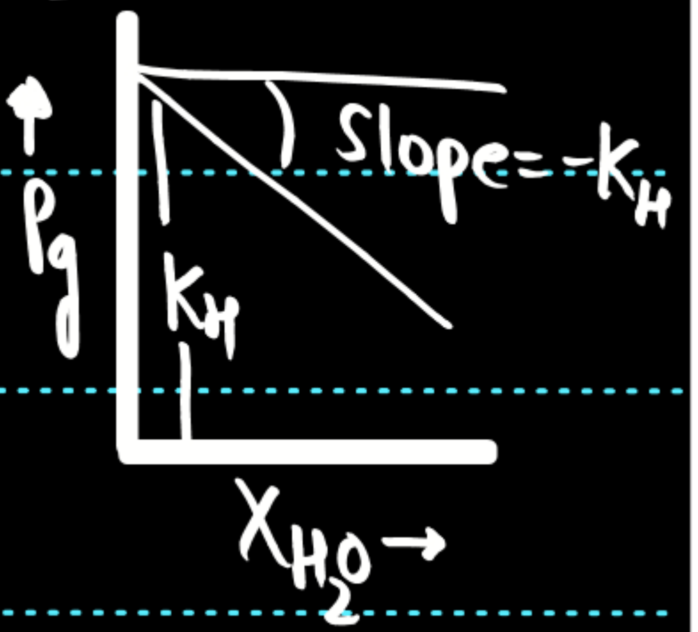


CSD

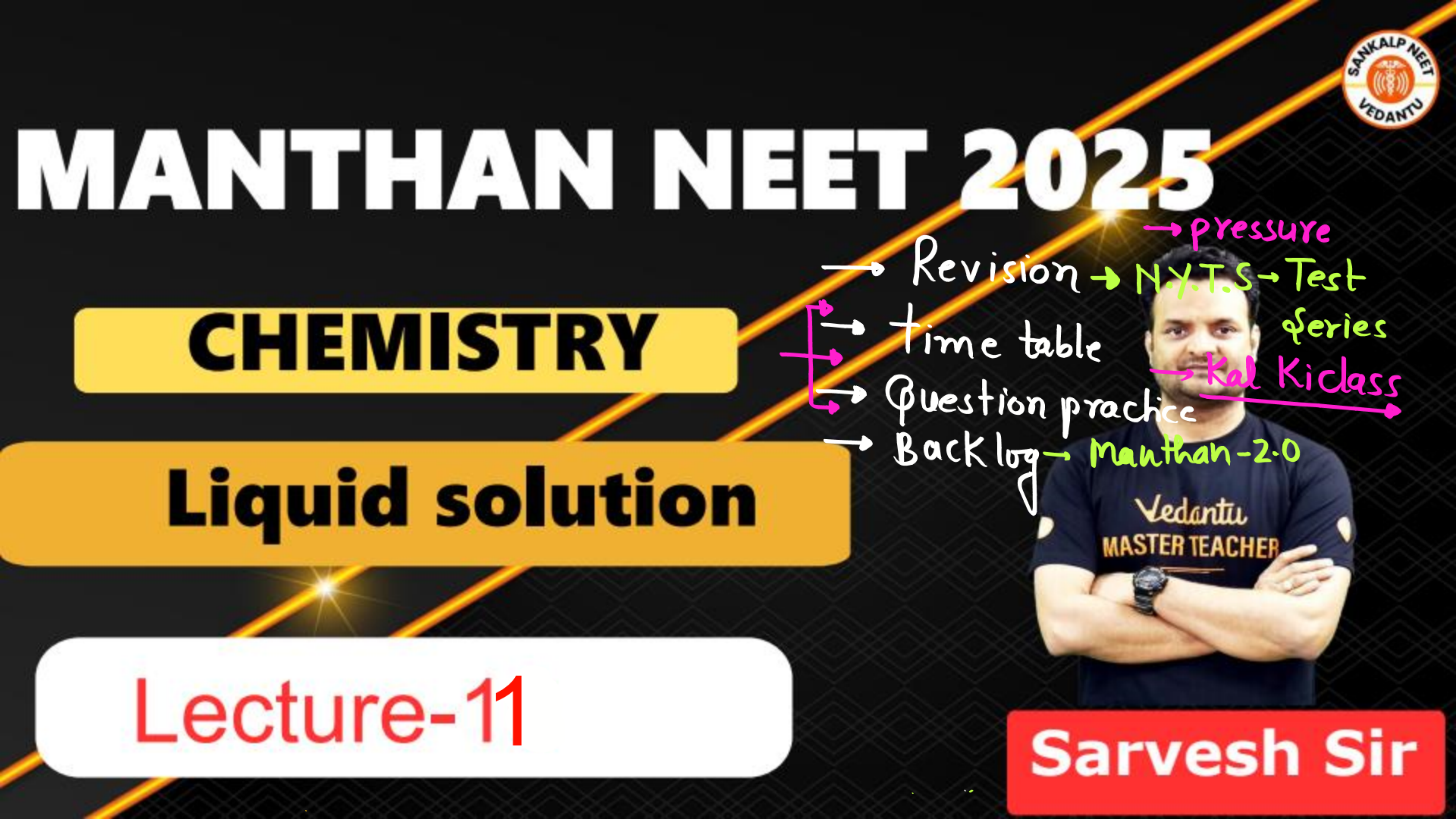
- undissolve gas ⇌ dissolve gas, $\Delta H = -ve$
- solubility $\propto \dfrac{1}{\text{temperature}}$
- polar gas + polar solvent = more soluble
- nonpolar gas + nonpolar solvent = more soluble
- solubility $\propto$ pressure
- $P_g = (K_H)_g \cdot X_g$

- (K_H) → temp & nature of gas = depend krti hai
- $K_H \propto$ temperature
- solubility $\propto \dfrac{1}{(K_H)_g}$
- $X_g = \dfrac{n_g}{n_g + n_{H_2O}}$, $X_g + X_{H_2O} = 1$






THANK YOU



SANKALP NEET
VEDANTU
MANTHAN NEET 2025
CHEMISTRY
Liquid solution
Lecture-11
→ pressure
→ Revision → N.Y.T.S → Test series
→ time table
Kal Ki class
→ Question practice
→ Backlog → Manthan-2.0
Vedantu
MASTER TEACHER
Sarvesh Sir

Today's Goal -

HENRY'S LAW



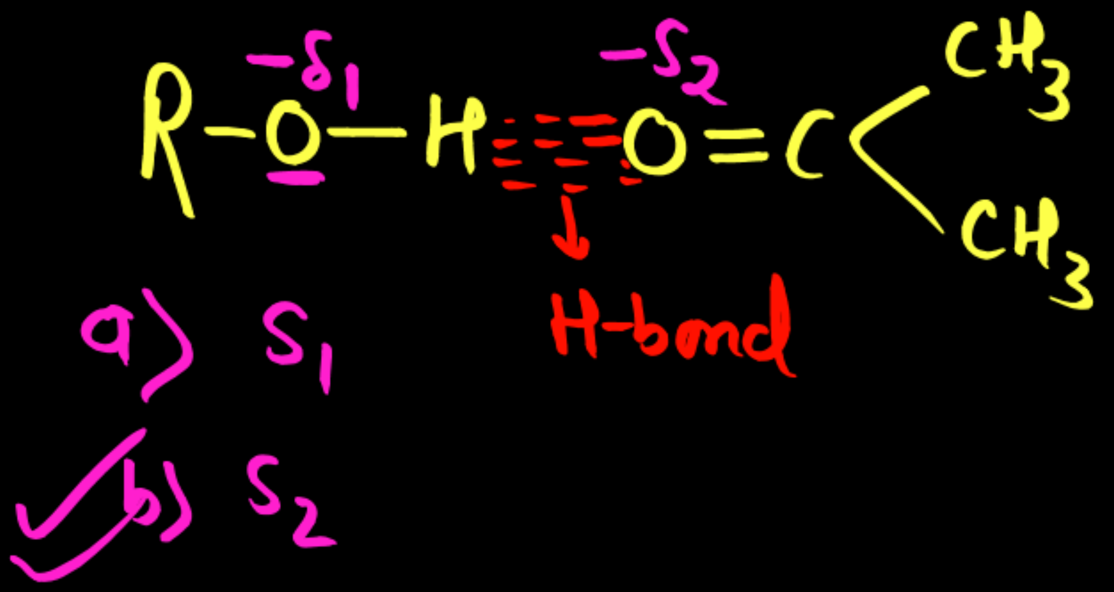
Qsd-1 A solution of acetone in ethanol **[CBSE AIPMT 2006]**

(a) shows a negative deviation form Raoult's law

(b) shows a positive deviation from Raoult's law

(c) behaves like a near ideal solution

(d) obeys Raoult's law



Qsd-2 All form ideal solution except

[CBSE AIPMT 1998]

(a) C_6H_6 and $C_6H_5CH_3$ ✗

(b) C_2H_5Cl and C_2H_5I ✗

(c) C_6H_5Cl and C_6H_5Br ✗

(d) C_2H_5I and C_2H_5OH → +ve deviation

C_2H_5-O-H → H-bonding

$\frac{?}{2}$

Q

Gas		Henry's Constant (K_H)
A	→	1.25 bar
B	→	0.75 bar
C	→	1.37 bar

↑ Solubility $\propto \frac{1}{(K_H)_g}$ ↓

Which Gas is maximum soluble in Common solvent

a) A b) B ✓ c) C d) all equal soluble

Q What mole of CO_2 gas dissolve in 90 gram of water at 300K temperature and 2atm pressure in close container (K_H of CO_2 gas is 4atm)

a) 0.5

b) 0.25

c) 0.42

d) NONE

$n_g = 5$ mole

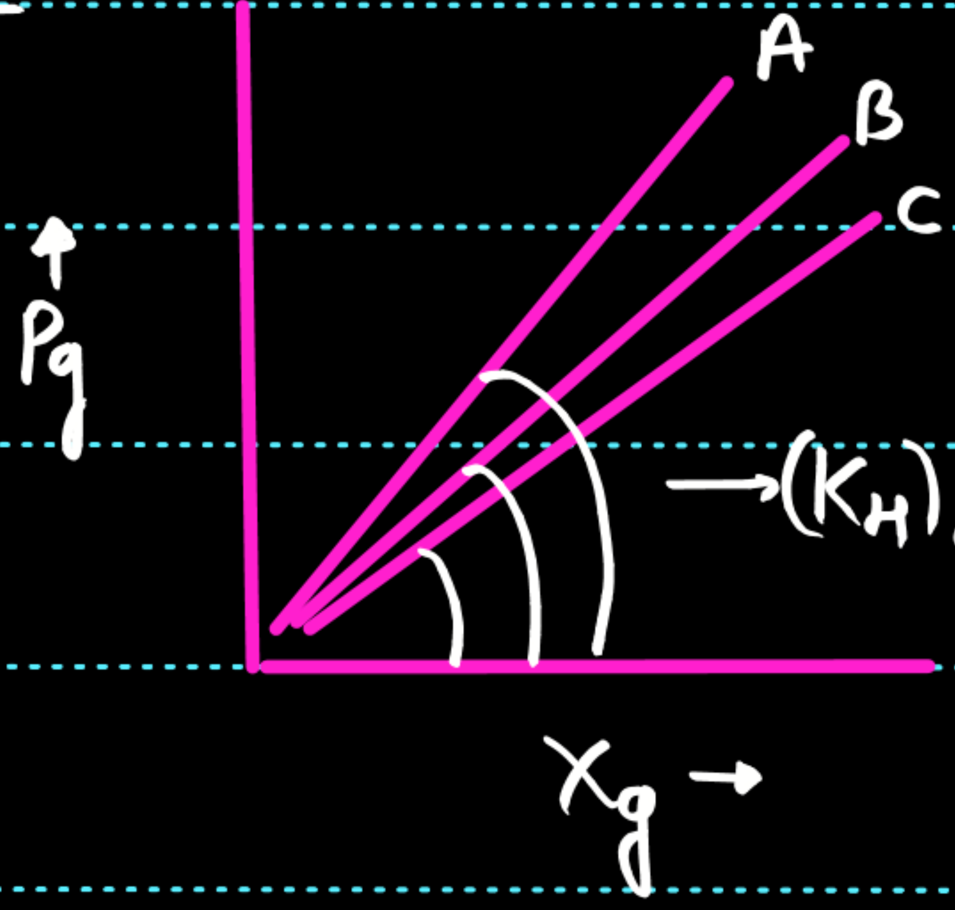
$$P_g = (K_H)_g \cdot X_g$$

$$2\text{atm} = 4\text{atm} \cdot X_g$$

$$X_g = \frac{1}{2}$$

$$\frac{n_g}{n_g + \frac{90}{18}} = \frac{1}{2} \Rightarrow 2n_g = n_g + 5$$

Q



$\rightarrow (K_H)_C < (K_H)_B < (K_H)_A$

Which Gas is least soluble

a) A b) B c) C d) Can not Calculate

$P_g = (K_H)_g X_g$

$y = m x$

Slope = K_H

Solubility $\propto \frac{1}{K_H}$

Note → Raoult's law is a special Case of Henry's law

→ true → Re-exam-2024 NEET → 1563

$P_g = (K_H)_g X_g$ → Henry's law

$(K_H)_g \rightarrow P_g^\circ$ (vapour pressure of gas)

$P_g = P_g^\circ \cdot X_g$ → Raoult's law

$P_A = P_A^\circ \cdot X_A$ → Raoult's law

Q56. An ideal solution is formed when its compounds [CBSE AIPMT 1998]

(a) have no volume change on mixing → $\Delta V = 0$

(b) have no enthalpy change on mixing → $\Delta H = 0$

(c) ✓ have both the above characteristics → $\Delta H = 0, \Delta V = 0$

(d) have high solubility

$\Delta H = 0$

$\Delta V = 0$

$f_A = f_B = f_{AB}$

$\Delta S = +ve$

$\Delta G = -ve$

$P_T = P_A + P_B$

H.W.

Intext Questions

2.1 Calculate the mass percentage of benzene (C_6H_6) and carbon tetrachloride (CCl_4) if 22 g of benzene is dissolved in 122 g of carbon tetrachloride.

2.2 Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride. → Karo

2.3 Calculate the molarity of each of the following solutions: (a) 30 g of $Co(NO_3)_2 . 6H_2O$ in 4.3 L of solution (b) 30 mL of 0.5 M H_2SO_4 diluted to 500 mL.

2.4 Calculate the mass of urea (NH_2CONH_2) required in making 2.5 kg of 0.25 molal aqueous solution.

2.5 Calculate (a) molality (b) molarity and (c) mole fraction of KI if the density of 20% (mass/mass) aqueous KI is 1.202 g mL^{-1}.

31.5×4 $\frac{1260}{12}$

$X_B = \frac{n_B}{n_B + n_{CCl_4}}$

$= \frac{30/78}{\frac{30}{78} + \frac{70}{138}}$

Soln 2.2 $X_B = ?$

30% (w/w) — solute, soln

30 gram solute (B)

100 gram soln (B + CCl_4)

Mass of CCl_4 = 100 − 30 = 70 g

2.22 At 300 K, 36 g of glucose present in a litre of its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of the solution is 1.52 bars at the same temperature, what would be its concentration?

2.23 Suggest the most important type of intermolecular attractive interaction in the following pairs.

(i) n-hexane and n-octane → $F_A = F_B = F_{AB}$

(ii) I_2 and CCl_4 → $F_A = F_B = F_{AB}$

(iii) $NaClO_4$ and water → $F_A = F_B < F_{AB}$

(iv) methanol and acetone → $F_A = F_B < F_{AB}$

(v) acetonitrile (CH_3CN) and acetone (C_3H_6O). → $F_A = F_B > F_{AB}$

2.24 Based on solute-solvent interactions, arrange the following in order of increasing solubility in n-octane and explain. Cyclohexane, KCl, CH_3OH, CH_3CN.

Soln 2.22 → 36g glucose → 1 litre soln → $\pi = 4.98$ bar

→ $\pi = 1.52$ bar

$\pi = iCRT$

$C = ?$

$1.52 = 1 \times C \times 0.0821 \times 300$

$C = 0.617M$

cyclohexane > CH_3CN > CH_3OH > KCl

Tsd-1

Q. At 323 K, the vapour pressure in millimeters of mercury of a methanol – ethanol solution is represented by the equation

$P = 120X_A + 140$, where X_A is the mole fraction of methanol. Then the value PA

(A) 120 mm

(B) 140 mm

(C) 260 mm ✓

(D) NONE

$P_A = 120 + 140$

$= 260$

$P = 120X_A + 140$

$P = (P_A - P_B)X_A + P_B$

$P_B = 140$

$P_A - P_B = 120$

$P_A = 120 + P_B$

$= 120 + 140$

$= 260$

Q. Mol fraction of the component A in vapour phase is x_1 (Y_A) and mol fraction of component A in liquid mixture is x_2 (X_A) then ($P_A{}^0$ = vapour pressure of pure A; $P_B{}^0$ = vapour pressure of pure B). then total vapour pressure of the liquid mixture is- ($P_T = ?$)

Tsd-2

(A) $\frac{P_A^0 x_2}{x_1}$ ✓

(B) $\frac{P_A^0 x_1}{x_2}$

(C) $\frac{P_B^0 x_1}{x_2}$

(D) $\frac{P_B^0 x_2}{x_1}$

$$Y_A = \frac{P_A}{P_T} = \frac{P_A^0 X_A}{P_T}$$

$$P_T = \frac{P_A^0 X_A}{Y_A} = \frac{P_A^0 x_2}{x_1}$$

Q. Find molar mass of a non-volatile solute whose 20 g on dissolving in 500 g of water produces a solution having boiling point = 105.2°C.
[K_b = 0.52 k kg mole^{-1}]

Tsd -3

$(T_b)_{soln}$

$(T_b)_{solv.} = 100°C$

(A) 8 g mol^{-1}

(B) 6 g mol^{-1}

(C) 4 g mol^{-1}

(D) 12 g mol^{-1}

$m = \frac{n_q}{M_{solv.}(gram)} \times 10^3$

$\Delta T_b = i K_b m$

$5.2 = 1 \times 0.52 \times m$

$m = 10$

$10 = \frac{20/M}{500} \times 1000$

$10 = \frac{20 \times 2}{M}$

$M = 4$

Q. The freezing point of the solution obtained by dissolving 0.5 moles of glucose in 500 g of water will be ($K_f = 1.86$)

Tsd-4

(A) –1.86°C

(B) –3.2°C

(C) –0.92°C

(D) –2.24°C

$\Delta T_f = (T_f)_{soln}$

$\Delta T_f = i K_f m$

$= 1 \times 1.86 \times \frac{0.5}{500} \times 1000$

$\Delta T_f = 1.86$

$(T_f)_{soln} = -\Delta T_f = -1.86$

Q. When $FeCl_3$ reacts with $K_4[Fe(CN)_6]$ in aqueous solution blue colour of ferri ferrocyanide, $Fe_4[Fe(CN)_6]_3$ is obtained. There are 0.1 M $FeCl_3$ and 0.01 M $K_4[Fe(CN)_6]$ solution are separated by a semi-permeable membrane as shown and osmosis occurs then

Tsd -5

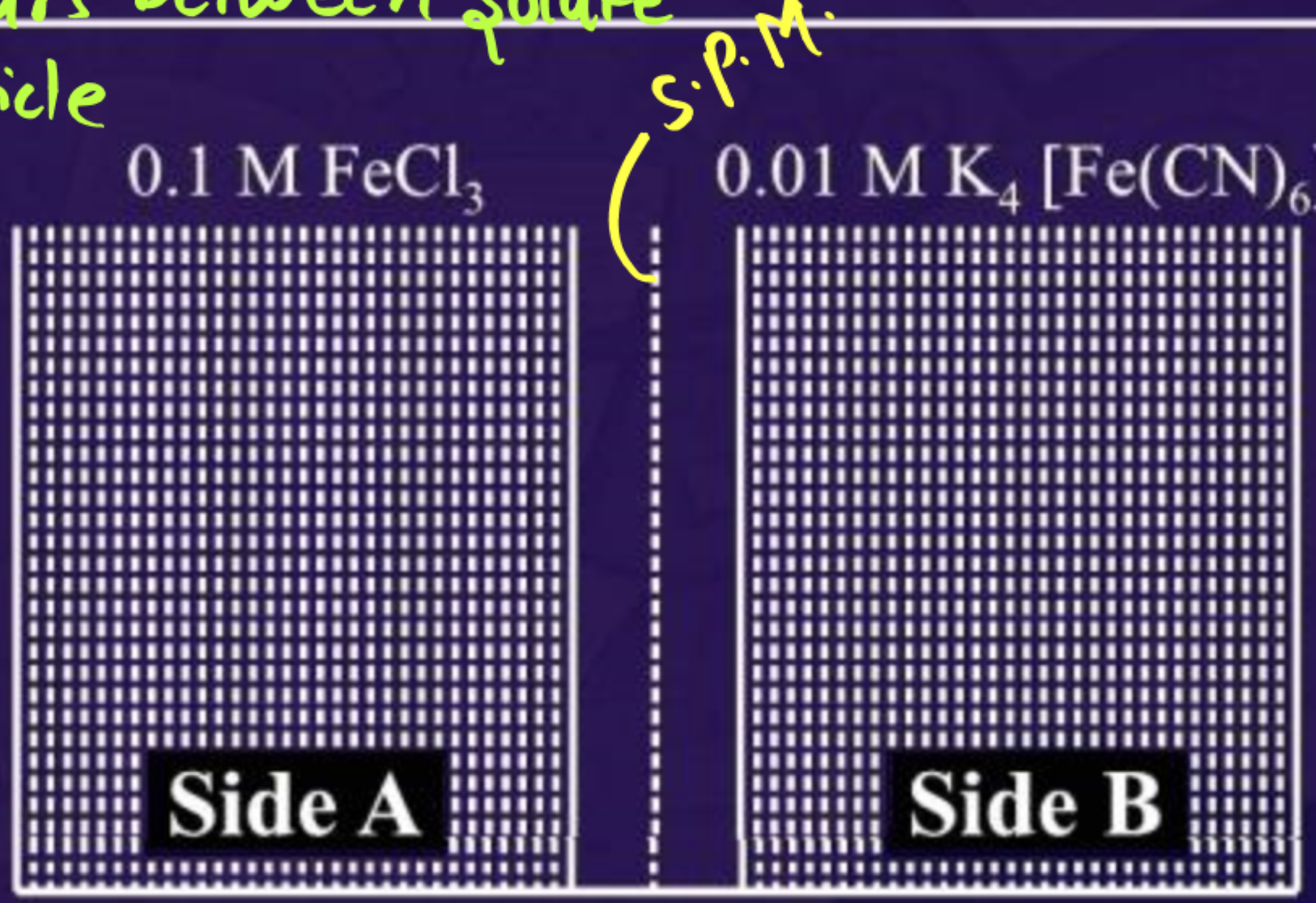
No Rxn occurs between solute particle

(A) blue colour is seen in side-B

(B) blue colour is seen in side-A

(C) blue colour is seen in both sides A and B

(D) no blue colour is seen in either side



Q. $K_2[PtCl_4]$ is 30% ionized in aqueous solution. The value of its Vant Hoff factor is

Tsd-6

$\alpha = 0.3$

(A) 1.2

(B) 1.4

(C) 1.6 ✓

(D) 1.8

$K_2[PtCl_4] \rightarrow 2K^+ + [PtCl_4]^{-2}$

$i = 1 + (n-1)\alpha$

$i = 1 + (3-1) \times 0.3$

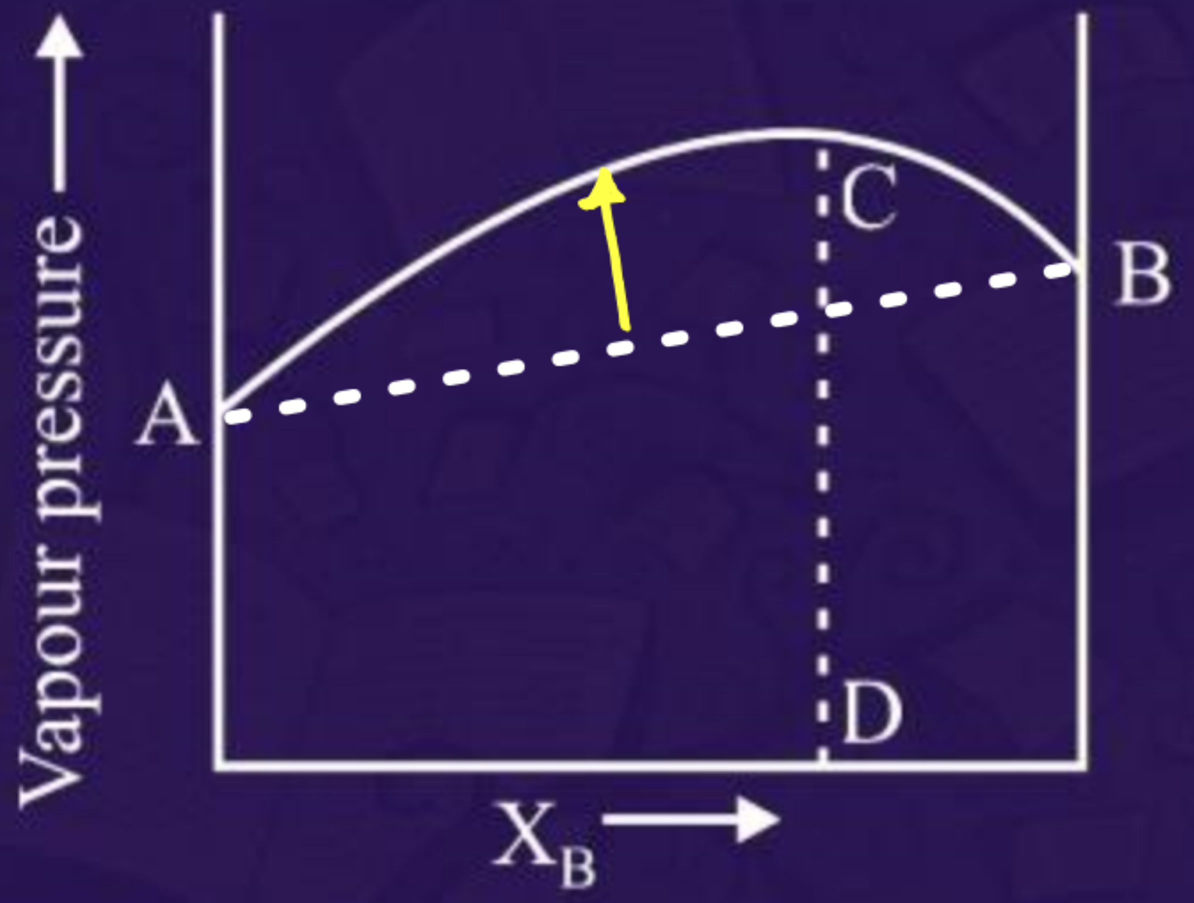
$= 1 + 2 \times 0.3 = 1.6$

Q. The diagram given below is a vapour pressure composition diagram for a binary solution of A and B.

Tsd-7

↑v.p. ∝ 1/force↓

$F_A = F_B > F_{AB}$



In the solution, A – B interactions are

(A) similar to A–A and B–B interactions

(B) greater than A–A and B–B interactions

(C) smaller than A–A and B–B interactions

(D) unpredictable

Tsd-8

Q. What is correct sequence of osmotic pressure 0.01 M aqueous solution:

(a) $Al_2(SO_4)_3$ (b) K_3PO_4 (c) $BaCl_2$ (d) Urea

$\eta = 5 = i$ $\eta = 4 = i$ $\eta = 3 = i$ $i = 1$

$\pi = iCRT$ — C, R, T → same

$\pi \propto i$

(A) $\pi_4 > \pi_3 > \pi_2 > \pi_1$

(B) $\pi_1 > \pi_2 > \pi_3 > \pi_4$

(C) $\pi_1 = \pi_2 > \pi_3 = \pi_4$

(D) $\pi_2 > \pi_4 > \pi_1 > \pi_3$

Q. Gases with their Henry's constant values are given. The gas having maximum solubility will be

Tsd-9

Gas A K_H = 21.2 k bar
Gas B K_H = 11.2 k bar
Gas C K_H = 5.6 k bar
Gas D K_H = 2.4 k bar

(A) A

(B) B

(C) C

(D) D

↑ Solubility $\propto \frac{1}{K_H}$ ↓
max min

Tsd-10

20gram Urea (60) 250gram water solⁿ-1, 20gram glucose (180) in 250gram water solⁿ-2, and 20gram sucrose (342) in 250gram water in solⁿ-3, have Osmotic pressure, π_1, π_2 & π_3 Respectively. Arrange Value of π_1, π_2 & π_3 in increasing oder NEET-2022 or 23

a) $\pi_1 > \pi_2 > \pi_3$ ✓

b) $\pi_1 = \pi_2 = \pi_3$

c) $\pi_1 < \pi_2 < \pi_3$

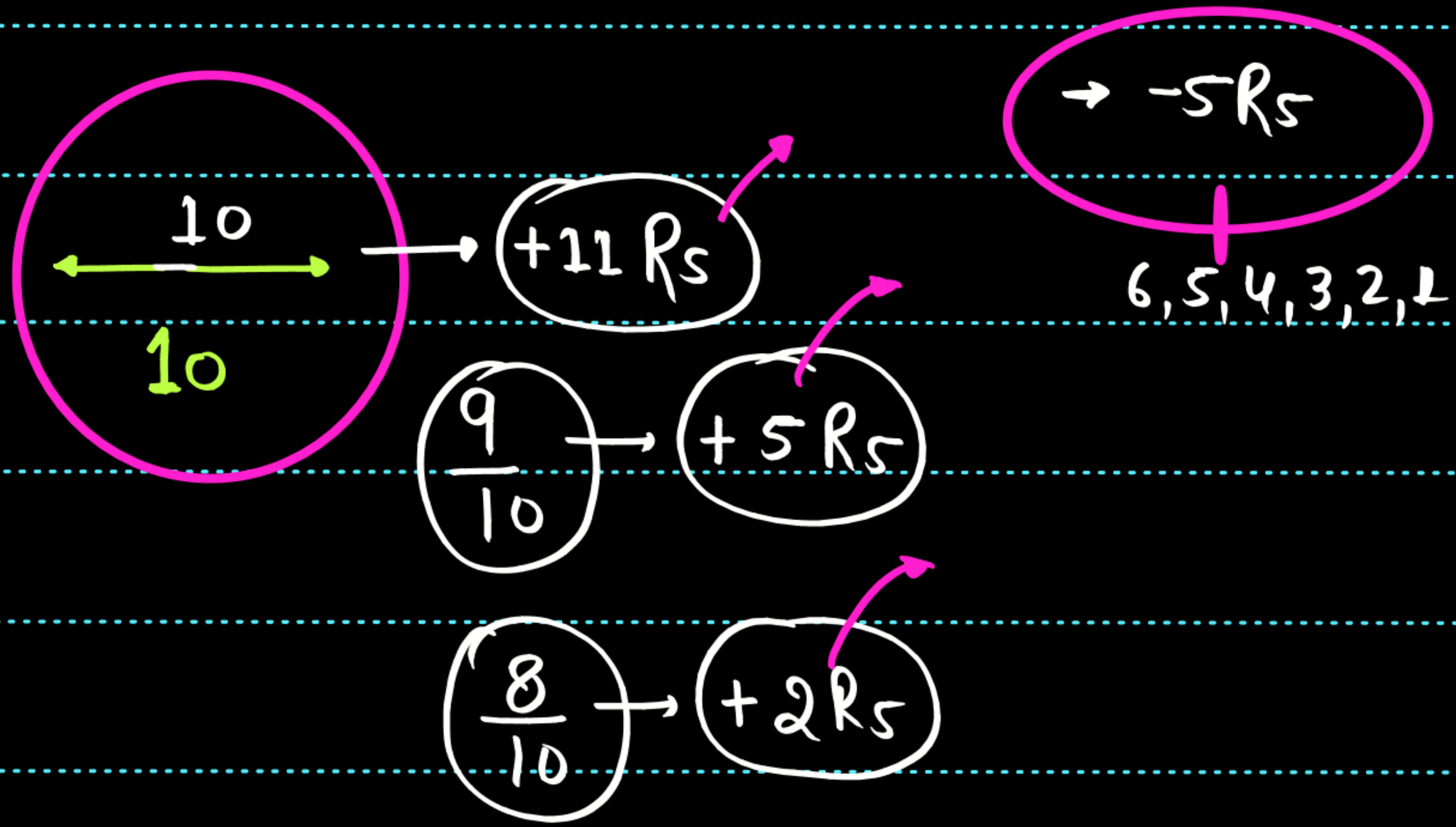
d) $\pi_2 > \pi_1 > \pi_3$

$$\pi = iCRT = i \times \frac{n}{M/kg} \times R \times T$$

$$\pi \propto n$$

$$\pi \propto \frac{W_{solute}}{M \cdot Wt} \Rightarrow \pi \propto \frac{1}{M \cdot Wt}$$

$$\pi_1 > \pi_2 > \pi_3$$


10
10
+11 Rs
9/10
+5 Rs
8/10
+2 Rs
→ -5 Rs
6, 5, 4, 3, 2, 1


THANK
YOU

MANTHAN NEET 2025

SANKALP NEET VEDANTU

CHEMISTRY

Liquid solution

Lecture-12

→ Summary Lec
→ Subtopic → Question
→ Tsd →
100% Question



Sarvesh Sir

Today's Goal -

Summary lecture

CSD

uniformally distribution

Solution → Min. 2-Component Homogeneous mixture

Solvent → large scale

Solute → small scale

binary Solution → 2-Component (Solvent + solute)

→ Solvent Ke nature (physical State) pr solution Ka nam Rakhte hai

Ex → H_2O + glucose, $H_2O + O_2$, H_2O + Alcohol } → liquid sol^n

→ 9 type solution possible, but gas-gas sol^n is called gaseous mixture, so → mainly 8 type

Table 1.1: Types of Solutions

→ ** Imp.

Type of Solution	Solute	Solvent	Common Examples
Gaseous Solutions	Gas	Gas	Mixture of oxygen and nitrogen gases
	Liquid	Gas	Chloroform mixed with nitrogen gas
	Solid	Gas	Camphor in nitrogen gas
Liquid Solutions	Gas	Liquid	Oxygen dissolved in water
	Liquid	Liquid	Ethanol dissolved in water
	Solid	Liquid	Glucose dissolved in water
Solid Solutions	Gas	Solid	Solution of hydrogen in palladium
	Liquid	Solid	Amalgam of mercury with sodium
	Solid	Solid	Copper dissolved in gold

3 (Gaseous Solutions)

Note → gas-gas solution ko gaseous mixture bolte hai

3 (Liquid Solutions)

3 (Solid Solutions)

9-type

mainly 8 type ke solⁿ hote hai

Tsd-1 How many solution are example of liquid solution

sugar solution ✓, Air ✗, H_2 gas in Pt-metal ✗, Alcohol + water ✓

$Hg-Zn$ ✗ (Hg → liq, Zn), fog → gaseous solⁿ (Air)

a) 2 ✓

b) 3

c) 1

d) 4

CSD → **Vapour pressure** → pressure exerted by vap. of liq. on the surface of liq. in close container at Eq. (evap. $\rightleftharpoons$ Cond^n)

Condition → Close container, volatile liquid nature

→ $H_2O(l) \rightleftharpoons vap.(H_2O)$, $\Delta H_{vap} = +ve$, $P_{vap} = K_{eq}$

*** → Vap. pressure of pure liq. Only depend upon temperature and nature of liquid, Reason ⇒ $P_{vap} = K_{eq}$ (only depend upon temp.)

→ Amount → ×, surface Area → ×, size, shape → ×

→ Vap. pressure (P_{vap}) $\propto$ temperature

$$\ln \frac{P_2}{P_1} = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$ → NEET nahi aya hai

<u>Where</u> T_1 K temp → Vap·pressure → P_1

T_2 K → P_2

ΔH_{vap} = Enthalpy of vapourization

→ Vapour pressure $\propto \dfrac{1}{\text{force b/w molecule}}$

CSP B.P. → T = b.p → $P_{vap} = P_{atm}$

→ $T_{b.p.} \propto P_{atm}$

→ water → P_{atm} = 1atm → $T_{b.p}$ = 100°C or 373K

→ B.P. ∝ Attraction force b/w two molecules of liquid

A.f. → Ion-Ion > H-bond > dipole-dipole > nonpolar-nonpolar

→ Vap. pressure ∝ temp.

→ Vap. pressure $\propto \frac{1}{B.P.}$

↓

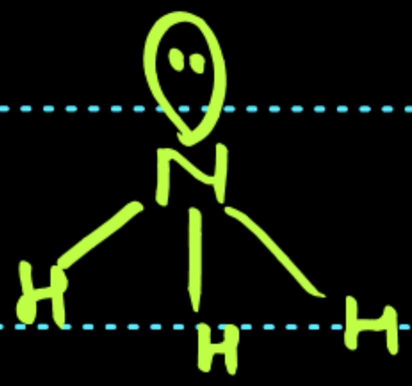
(2-liquid Ke compare me)

→ Vap. pressure $\propto \frac{1}{\text{Attract}^n \text{ Force b/w molecules}}$

Tsd-2 select Correct order of vapour pressure

✗ a) $CH_4 < \ddot{N}H_3$ → polar → $\mu \neq 0$

nonpolar



✗ b) $H_2O > C_2H_5OH$

✗ c) 100gram → C_6H_6 → V.P. = P_1atm , 50gram C_6H_6 → V.P = P_2atm

$P_1 > P_2$ → $V.P \propto \frac{1}{\text{Force}}$

✓ d) $CO_2 > \ddot{S}O_2$ → $\mu \neq 0$

O = C = O

$\mu = 0$



ⓧ $V.P. \propto \frac{1}{B.P.}$

CSD → Case-1 ⇒ both liquid (solute & solvent) = volatile nature

Raoult's law → $P_T = P_A + P_B$ = $P_A^0 X_A + P_B^0 X_B$

where → X_A, X_B = mole fractⁿ of liq-A & liq-B in liquid solution

→ P_A^0, P_B^0 ⇒ Vap. pressure of pure liq-A & liq-B

Note → P_A^0, P_B^0 = Const (not depend upon amount ⇒ Reason ⇒ $P_{vap}^0 = K_{eq}$)

→ $P_A \propto X_A$, $P_B \propto X_B$ (Partial vap. pressure of liq-A & liq-B in solution)

→ $P_T = (P_A^0 - P_B^0) X_A + P_B^0$ ⇒

→ $P_T = (P_B^0 - P_A^0) X_B + P_A^0$

→ suppose → $P_T = a X_A + b$ ⟶ $P_B^\circ = b$, $P_A^\circ = a+b$ (with sign)

CSD Case-1 ⇒ both liquids are volatile nature (Raoult's law)

Condition: $A \overset{F_A}{—} A = B \overset{F_B}{—} B = A \overset{F_{AB}}{—} B \Rightarrow F_A \simeq F_B \simeq F_{AB}$

suppose

2) liq-A & liq-B = NO Rxn

3) $\{P_T\} \rightarrow P_A^0$ to $P_B^0 \rightarrow P_A^0 \leq P_T \leq P_B^0 \rightarrow (P_A^0 < P_B^0)$, $P_A^0 \geq P_T \geq P_B^0 \rightarrow (P_A^0 > P_B^0)$

4) Mole of liq-A ≃ mole of liq-B → $\boxed{P_T = \frac{P_A^0 + P_B^0}{2}}$ → $X_A = \frac{1}{2}$, $X_B = \frac{1}{2}$

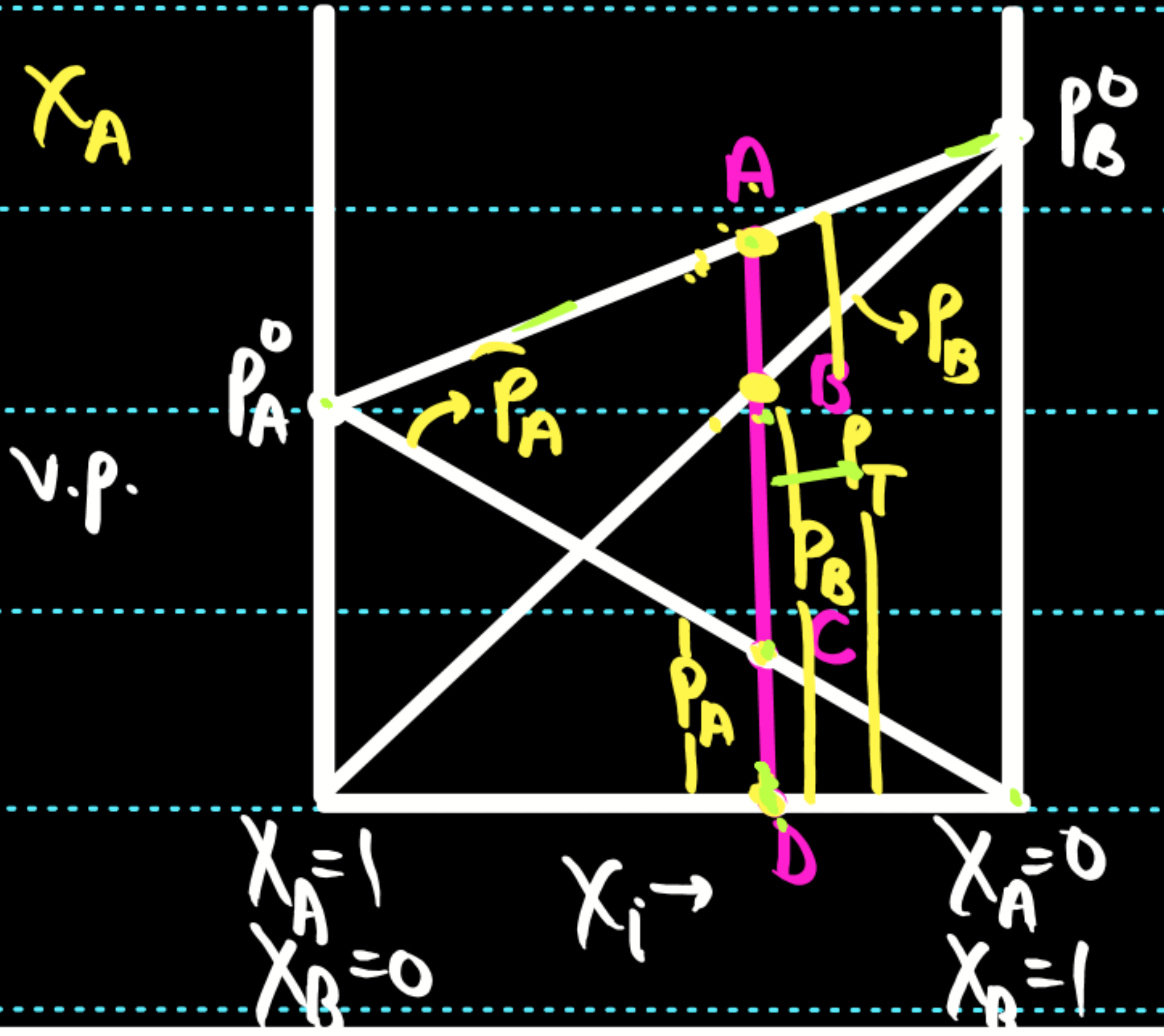
5) Composition of mixture of binary solution, when vap. pressure is minimum → $(P_T)_{min} \simeq P_A^0$ (Chhoda wala v.p. ke equal) → $X_A \simeq 1$, $X_B \simeq 0$

CSD 6) Maximum vap. pressure of sol^n $(P_T)_{max} \approx P_B^0$ (Jo vap. pressure of pure liq. bada hoga, uske equal) → $X_B = 1, X_A = 0$

7) $P_T = P_A + P_B$

$AD = DC + DB$

$P_A = P_A^0 X_A$



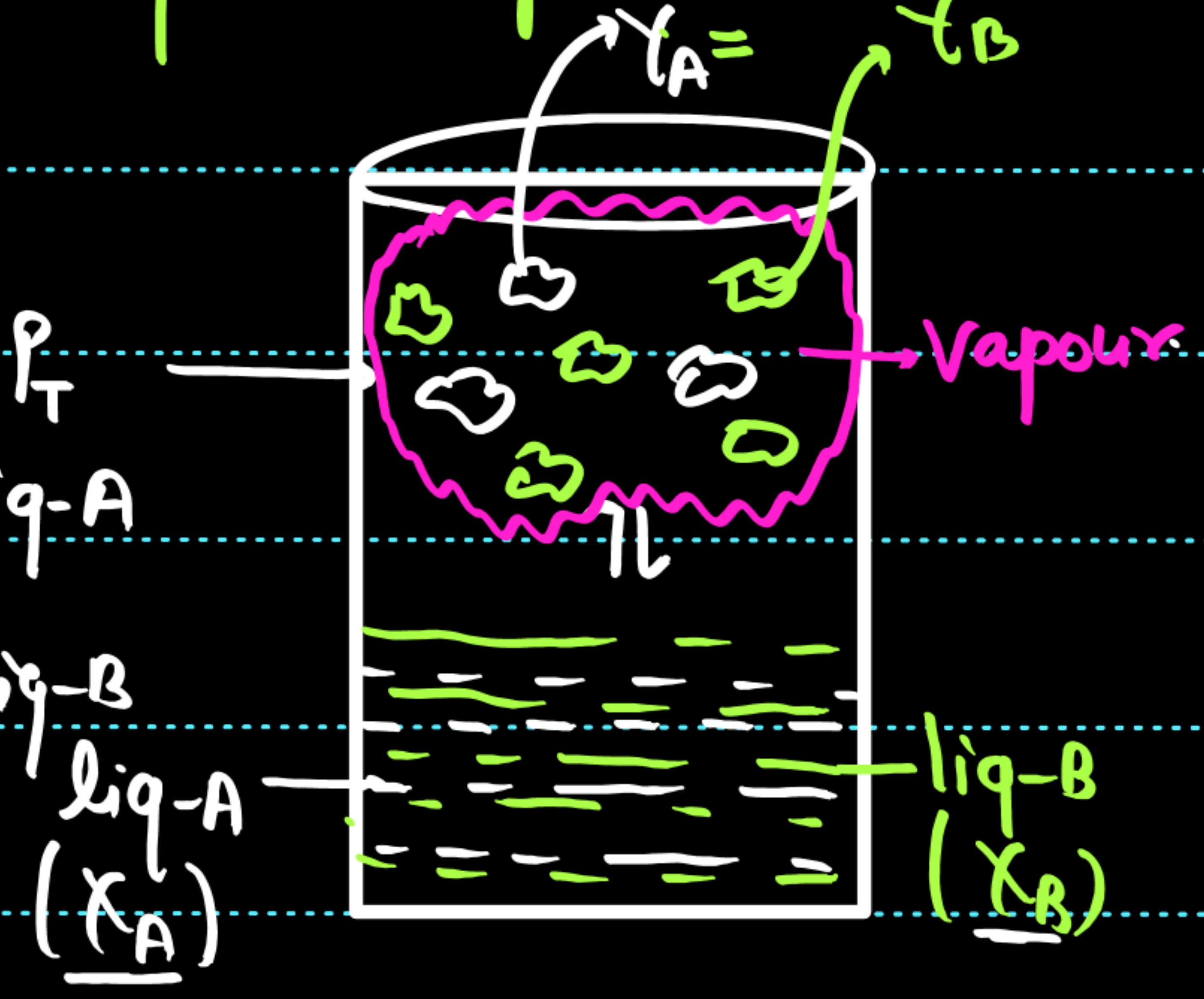
Composition of mole fraction of liq-A & liq-B in Vapour phase

X_A = mole fract^n of liq-A in liq. sol^n

X_B = mole fract^n of liq-B in liq. sol^n

Y_A = mole fract^n of vapour phase of liq-A

Y_B = mole fract^n of vapour phase of liq-B



$$Y_A = \frac{P_A}{P_T} = \frac{P_A^0 X_A}{P_A^0 X_A + P_B^0 X_B}$$

$$Y_B = \frac{P_B}{P_T} = \frac{P_B^0 X_B}{P_A^0 X_A + P_B^0 X_B}$$

CSD

→ Mole fraction of liq-A in vapour phase $(Y_A) = \frac{P_A}{P_T} = \frac{P_A^0 X_A}{P_A^0 X_A + P_B^0 X_B}$

→ Mole fraction of liq-B in vapour phase $(Y_B) = \frac{P_B}{P_T} = \frac{P_B^0 X_B}{P_A^0 X_A + P_B^0 X_B}$

→ $$\frac{Y_A}{Y_B} = \frac{P_A}{P_B} = \frac{P_A^0 X_A}{P_B^0 X_B} = \left(\frac{P_A^0}{P_B^0}\right)\left(\frac{n_A}{n_B}\right) = \left(\frac{P_A^0}{P_B^0}\right)\left(\frac{W_A}{W_B}\right)\left(\frac{M_B}{M_A}\right)$$

***

→ $Y_A + Y_B = 1$

$$\frac{Y_A}{Y_B} = \frac{\text{Molality} \times \text{M.wt of solvent}}{1000} \times \left(\frac{P_A^0}{P_B^0}\right)$$

Tsd-3 78 gram C_6H_6 dissolve in 18 gram water and form binary solution, select Correct option

$\frac{78}{78}$ $n=1$ $\frac{18}{18} \Rightarrow n=1$

$P_B^0 = 600$ mm, $P_W = 640$ mm of Hg

✓ a) P_T is equal to Avg. of v.p. of C_6H_6 & water

$$P_T = \frac{P_B^0 + P_W^0}{2}$$

✗ b) $P_T > 640$ mm Hg

✗ c) $P_T < 600$ mm Hg

d) Can not say

CSD → Case = 2 → solute (liq-A) = nonvolatile ($P_A^o = 0$)

→ $P_s = P_o X_B$ ($P_T = P_A + P_B$)

→ $P_o - P_s = P_o X_A$

→ $P_o > P_s$ = Nonvolatile solute milne se v.p. of solⁿ decrease krta hai ⇒ Reason ⇒ Scaping tendency of solvent molecule decreases due to decreasing of surface Area

→ $P_o - P_s$ = Lowering of vap. pressure in presence of nonvolatile solute

(Meaning = Kitna v.p. Kam ho gaya hai, nonvolatile solute milne

→ $P_o - P_s \propto X_A \propto$ Mole of solute

→ $P_s \propto \frac{1}{X_A \text{ or mole of solute}}$

$$\rightarrow \boxed{\frac{P_0 - P_s}{P_0} = X_A}$$

$\frac{P_0 - P_s}{P_0}$ = Relative Lowering of v.p. (R.L.V.P.)

↓

(Kitne fraction v.p. Kam ho gaya hai, non volatile solute milne se)

$\left(\frac{P_0 - P_s}{P_0}\right) \times 100$ = Kitne percentage v.p. of sol^n Kam ho gaya hai, nonvolatile solute milne se

Raoult's law Relative Lowering of v.p. of sol^n is equal to mole fraction of solute.

$$\left(\frac{P_0 - P_s}{P_0}\right) \propto X_A \propto \text{Mole of solute}$$

$$\frac{P_0 - P_s}{P_0} = \frac{n_A}{n_A + n_B} \Rightarrow \frac{P_0 - P_s}{P_s} = \frac{n_A}{n_B}$$ → universal formula all type of solⁿ

$$\frac{P_0 - P_s}{P_0} \approx \frac{n_A}{n_B}$$ → only for dilute solⁿ $\left(\frac{n_A}{n_B} = \frac{X_A}{X_B}\right)$

***

$$\frac{P_0 - P_s}{P_s} = \frac{W_A}{M_A} \times \frac{M_B}{W_B}$$

$$\frac{P_0 - P_s}{P_s} = \frac{X_A}{X_B} = \frac{\text{molality} \times \text{M.wt of solvent}}{1000}$$

Tsd-4 vapour pressure of aqueous solution at 373K temp. (→ 100°C) is 740 torr. Calculate mole fraction of solute in solution

a) 0.4

b) 0.21

c) 0.16

d) NONE ✓

e) data Kam diya hai

$$\frac{P_0 - P_s}{P_0} = X_A \rightarrow ?$$

Solvent = water

b.p. → 100°C, v.p = Patm = 760 torr

$$\frac{P_0 - 740}{P_0} = \frac{760 - 740}{760}$$

$$= \frac{20}{760} = \frac{2}{76} = \frac{1}{38}$$

CSP

Boiling Point ⇒ T = B.P → $P_{vap} = P_{atm}$

→ B.P ∝ P_{atm}

***

→ At Boinling point of liquid → $P_{vap} = P_{atm} = 1 atm = 760$ mm of Hg

elevation of b.p. $(\Delta T_b) = (T_b)_{soln} - (T_b)_{solv.}$

→ $(T_b)_{solution}$ ∝ Mole of nonvolatile solute

→ (ΔT_b) ∝ mole of solute

→ $\Delta T_b = K_b . m$

→ $\Delta T_b \propto m$, $\Delta T_b \propto \frac{n_{solute}}{(Mass)_{solvent}} \times 10^3$

→ $(T_b)_{soln} \propto m$

→ $\Delta T_b \propto K_b$ (m = Const)

→ $(T_b)_{soln.} \propto K_b$ (m = Const)

unit of $K_b = \frac{\Delta T_b}{m} = \frac{K}{\frac{mole}{kg}}$

$= mole^{-1}\, kg \times K$

CSD

$\Delta T_b = K_b m$	$\Delta T_f = K_f m$
where → ΔT_b = elevation of b.p.	Where → ΔT_f = depression in f.P.
$\uparrow \Delta T_b = \uparrow (T_b)_{sol^n} - (T_b)_{sol^v}$	$\uparrow \Delta T_f = (T_f)_{sol^v} - (T_f)_{sol^n} \downarrow$
→ $\Delta T_b \propto K_b$ (m = same ho)	→ $\Delta T_f \propto K_f$ (m = same ho)
→ $\Delta T_b \propto$ molality of sol^n	→ $\Delta T_f \propto$ molality of sol^n
→ $\Delta T_b \propto n_{solute}$ / mass of solvent	→ $\Delta T_f \propto n_{solute}$ / mass of solvent
→ $(T_b)_{sol^n} \propto \Delta T_b$	→ $(T_f)_{sol^n} \propto \frac{1}{\Delta T_f}$
→ $(T_b)_{sol^n} \propto K_b$, $(T_b)_{sol^n} \propto m$	→ $(T_f)_{sol^n} \propto \frac{1}{K_f}$, $(T_f)_{sol^n} \propto \frac{1}{m}$

CSD

$\Delta T_b = K_b m$

K_b = elevation Const or ebulloscopic Const

→ K_b only depend upon nature of solvent ($(solvent)_{vap} \rightleftharpoons (solvent)_{liq.\,sol^n}$)

→ $K_b = \dfrac{R T_b^2 \times M.wt\ of\ solvent}{1000 \times \Delta H_{vap}}$

T_b = b.p. of solvent

ΔH_{vap} = enthalpy of vapourisation

$\Delta T_f = K_f m$

K_f = depression Const. or Crayospoic const.

→ K_f only depend upon nature of solvent ($(solvent)_{liq\,sol^n} \rightleftharpoons (solvent)_{solid}$)

→ $K_f = \dfrac{R T_f^2 \times M.wt\ of\ solvent}{1000 \times \Delta H_f}$

T_f = f.p. of solvent

ΔH_f = enthalpy of freezing

CSD **Osmosis** → spontaneous migration of solvent molecule only through S.P.M.

1)

low Con. of sol^n or → high Con. of sol^n

high vap. pressure of sol^n → Low vap. pressure of sol^n. or

2) Only solvent molecule → migrate

solute → migrate nahi krte →

** Reason → size of solute > size of solvent

*** Solute of sol^n-1 does not react with solute of sol^n-2

3) **At Equilibrium**

Con. of sol^n-1 ⇌ Con. of sol^n-2

$$\frac{n_{solute}}{(Mass)_{solv} + w} = \frac{n_{solute}}{(Mass)_{solv} - w}$$

CSP Osmotic pressure → External pressure → $\pi + P_1 = P_2$ → stop Osmosis

→ $\pi = P_2 - P_1$

→ $\pi = CRT = \frac{n_{solute}}{\text{Vol of sol}^n} \times R \times T$

→ $\pi \propto n_{solute}$ (R, T, Vol of sol^n – same)

→ Isotonic solution → $\pi_1 = \pi_2$

→ $C_1 = C_2$

→ $\pi_1 > \pi_2$

π_1 ↓ Hypertonic sol^n

π_2 ↓ Hypotonic sol^n

→ Reverse Osmosis → $P_{ext} > \pi$

= Osmosis opposite direction me hone lagti hai

CSD → Colligative properties

↓ only depend upon No. of mole of solute particle

size → ×

nature → ×

1) $\frac{P_o - P_s}{P_o} = \frac{i n_A}{i n_A + n_B}$

2) $\Delta T_b = i K_b m$

3) $\Delta T_f = i K_f m$

4) $\pi = i CRT$

5) Case-1 = No Association or No Dissociation ⇒ $i = 1$

→ Hydrocarbon, Carbohydrate

→ Urea, glucose, sucrose etc.

6 → Case = 2 ⇒ Dissociation

$i = 1 + (n-1)\alpha$ ⇒ $i > 1$

α = degree of dissociation, n = total No of solute particles form by 1 mole of solute

→ Acid, Base, Salt → in water solvent

$\alpha = 1$ ⇒ $i = n$

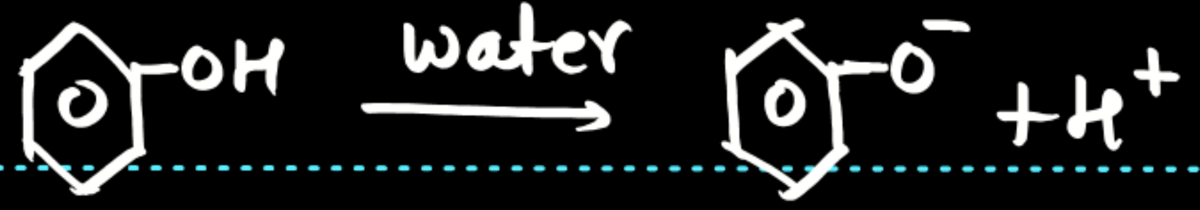
Case-3 = Association

$i = 1 + \left(\frac{1}{n} - 1\right)\alpha$

$i < 1$ → $\alpha = 1 \Rightarrow i = \frac{1}{n}$

$2CH_3COOH \underset{\text{Benzene}}{\rightleftharpoons} (CH_3COOH)_2$

Phenol



Note → Carboxylic acid → in polar solvent (H_2O)

$RCOOH \rightleftharpoons R\text{-}COO^- + H^+$

Carboxylic acid → nonpolar solvent (C_6H_6)

$2RCOOH \rightleftharpoons (RCOOH)_2$

$Hg_2Cl_2 \rightleftharpoons Hg_2^{+2} + 2Cl^-$



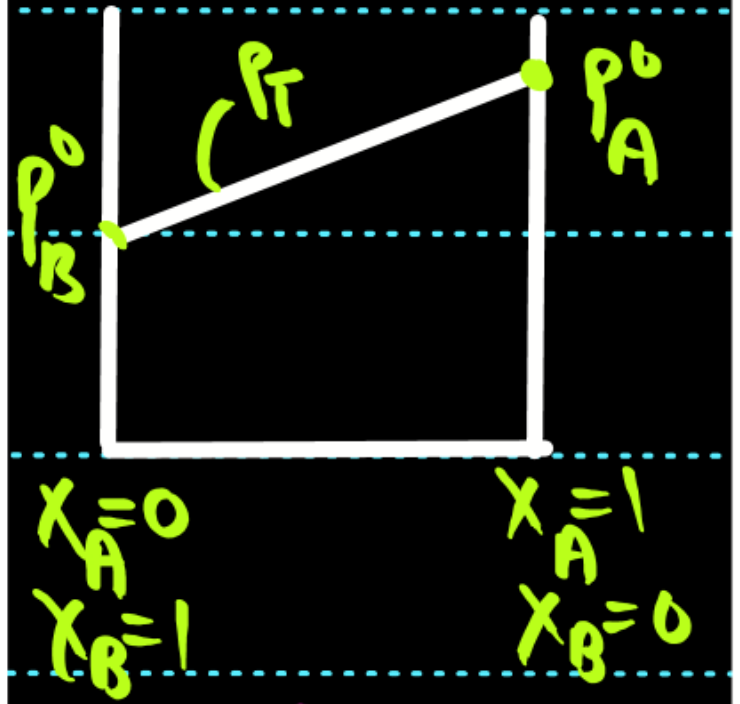
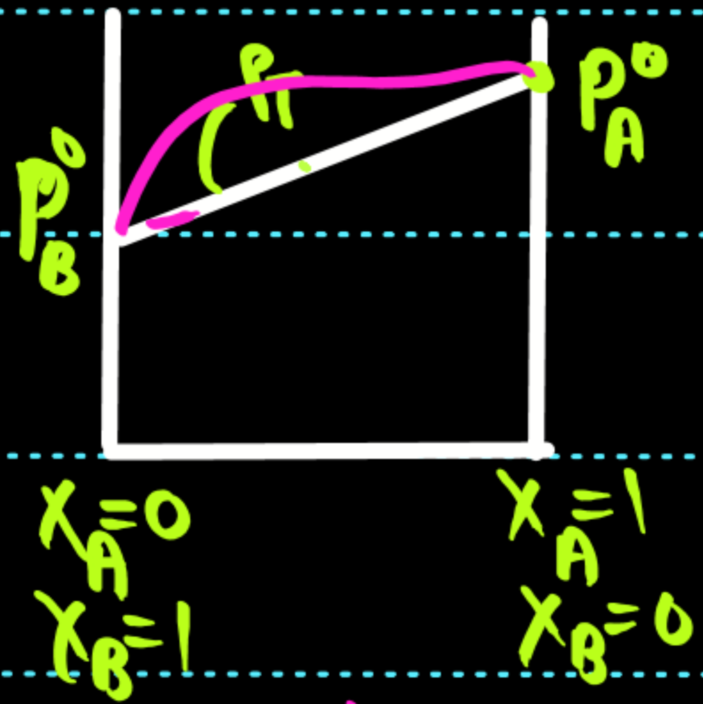
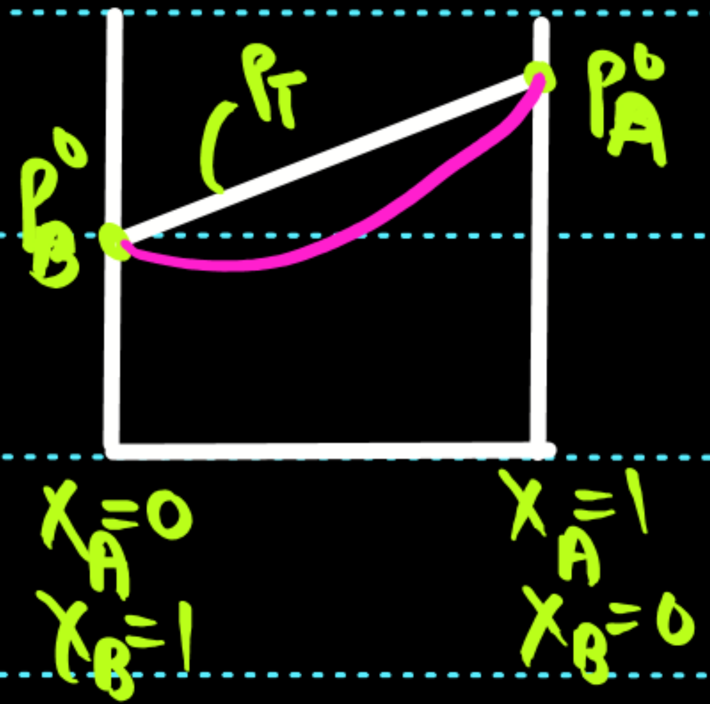
Note → $K_2HgI_4 \rightarrow K_2[HgI_4]$

$\rightarrow 2K^+ + [HgI_4]^{-2}$

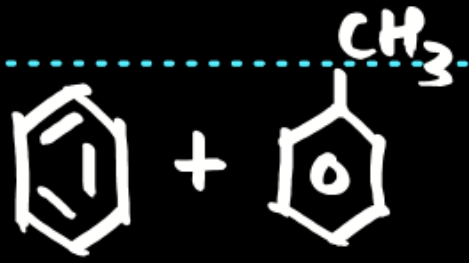
$Cu_2I_2 \rightarrow Cu_2^{+2} + 2I^-$

Properties	ideal solution	Positive deviation	Negative deviation
1) Attraction Force  A-A ⇒ F_A  B-B → F_B	$F_A = F_B = F_{A-B}$ A-A = B-B = A-B V.P. $\propto \frac{1}{\text{force}}$	$F_A \approx F_B > F_{A-B}$	$F_A \approx F_B < F_{A-B}$
2) Change in volume V_1 → Solute V_2 → Solvent V_{soln} = Solution ΔV =	$\Delta V = V_{soln} - (V_1 + V_2)$ $\Delta V = 0$	$\Delta V = +ve$	$\Delta V = -ve$

Properties	ideal solution	Positive deviation	Negative deviation
3) Change in enthal-py (ΔH)	$\Delta H = 0$	$\Delta H = +ve$	$\Delta H = -ve$
$\Delta H = H_{soln} - H_{solute} + H_{solv}$ H_{soln}: $-ve$, H_{solute}: $+ve$, H_{solv}: $+ve$			
4) Entropy change $(\Delta S)_{soln}$	$(\Delta S)_{soln} = +ve$	$(\Delta S)_{soln} = +ve$	$(\Delta S)_{soln} = +ve$

Properties	ideal solution	Positive deviation	Negative deviation
5) Gibbs free energy change (ΔG)	$(\Delta G)_{sol^n} = -ve$	$(\Delta G)_{sol^n} = -ve$	$(\Delta G)_{sol^n} = -ve$
6) Vapour pressure of sol^n.	 $(P_T)_{Exp} = P_{R.L.}$	 $(P_T)_{Exp} > P_{R.L.}$	 $(P_T)_{Exp} < P_{R.L.}$

Properties	ideal solution	Positive deviation	Negative deviation
7) Csd →	$F_A = F_B = F_{AB}$	$F_A = F_B > F_{AB}$	$F_A = F_B < F_{AB}$
	solute aur sol	solute aur solvent	solute aur solvent
	-vent milne pr	Ko milne pr	Ko milne pr, force
	force approx same	force Kam ho	increase ho raha
	log Raha hai	Raha hai	hai
	Ex→ $C_6H_6 + C_7H_8$	Ex→ $H_2O + CCl_4$	H_2O + Acid
	Ex $CCl_4 + CBr_4$	Ex→ H_2O + nonpolar	H_2O + Base H_2O + salt

Properties	ideal solution	Positive deviation	Negative deviation
(F, O, N)–H	Ex 	H_2O + Molecule (not ionise in water)	$H_2O + HCl$ $H_2O + NaOH$ $H_2O + NaCl$ $H_2O + HNO_3$
	Ex→ 	$H_2O + C_2H_5OH$	

Force order → Ion-Ion > H-bond > dipole-dipole > nonpolar-nonpolar

Note $CH_3COCH_3 + CHCl_3$

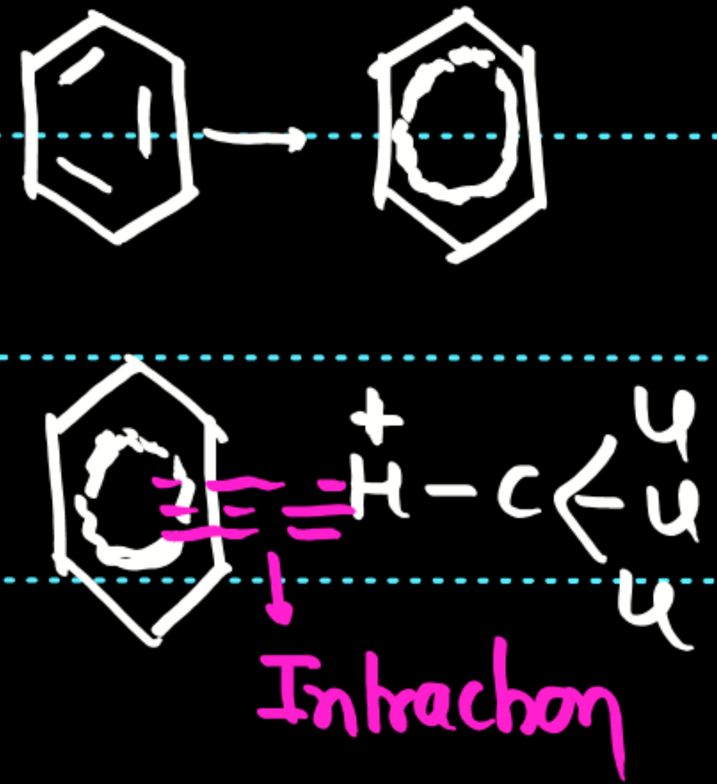
$>C=\overset{-}{O} \equiv \overset{+}{H}-C \lessdot Cl_3$

↓

H-bond

Properties	ideal solution	Positive deviation	Negative deviation

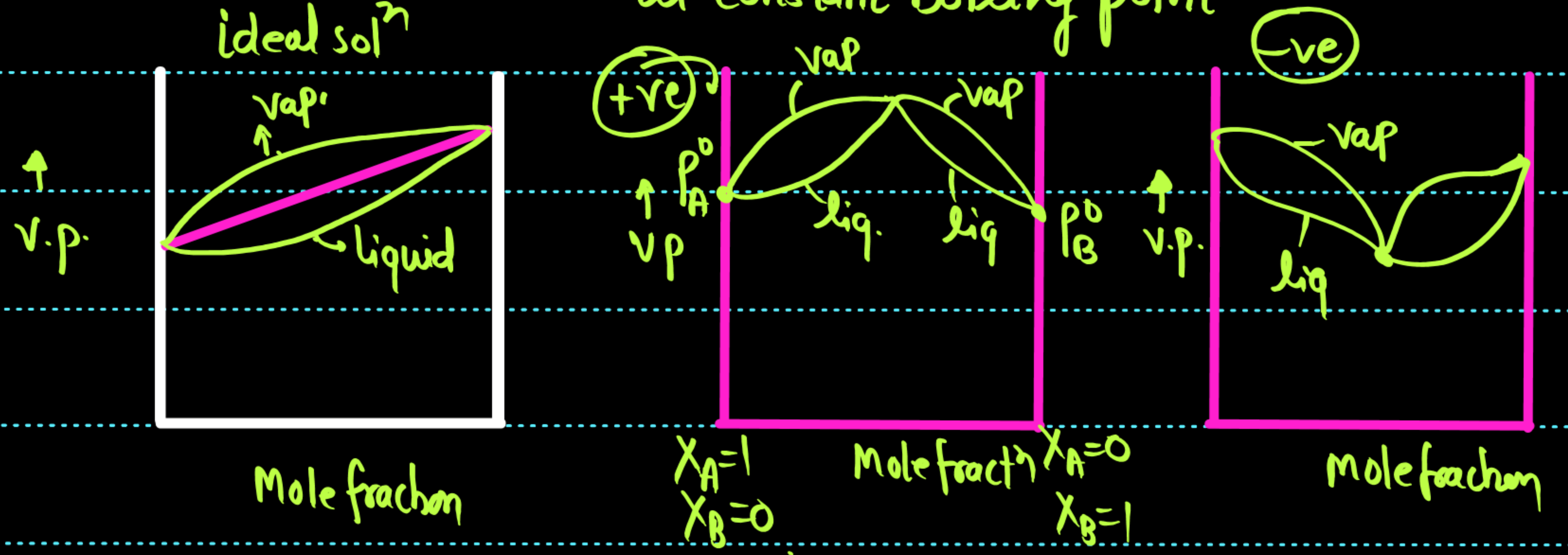
Note $C_6H_6 + CHCl_3$



Properties	ideal solution	Positive deviation	Negative deviation
8) Azeotropic mixture	ideal solution seperated by fractional distillation method → nonazeotropic mixture	Those solution (non-ideal) which is not 100% seperated by fractional distillation method → Azeotropic mixture	
		Azeotropic mixture	
		Minimum boiling Point azeotropic	Maximum boiling point Azeotropic mixture

Reason → Mole fraction of liquid phase = mole fraction of vapour phase

$X_A = Y_A$
$X_B = Y_B$
→ all solution convert into vapour phase at constant boiling point



CSD

→ undissolve gas ⇌ dissolve gas, $\Delta H = -ve$

→ solubility $\propto \frac{1}{\text{temperature}}$

→ polar gas + polar solvent = more soluble

→ nonpolar gas + nonpolar solvent = more soluble

→ solubility ∝ pressure

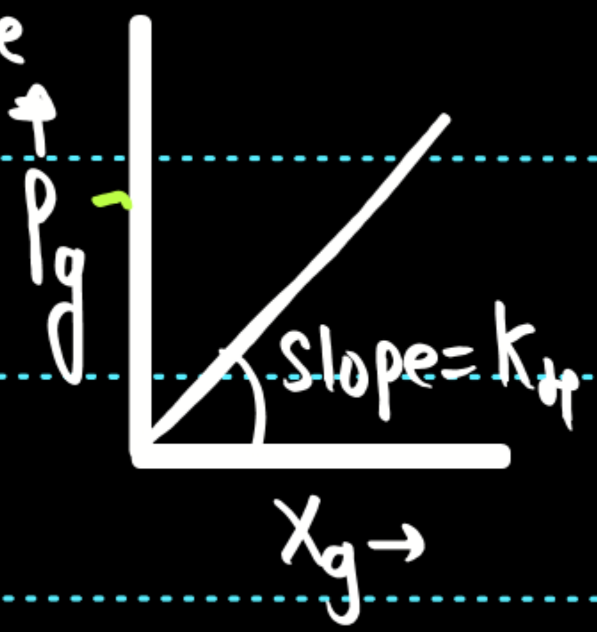
→ $P_g = (K_H)_g \cdot X_g$.

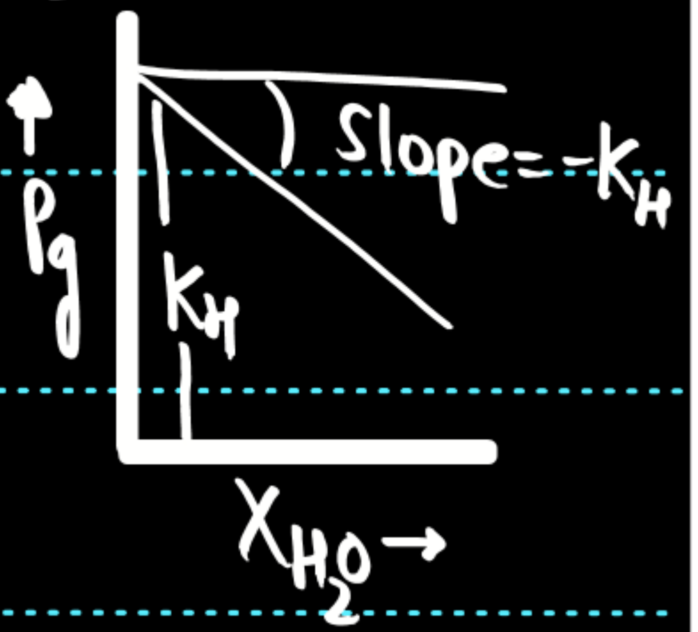
→ (K_H) → temp & nature of gas = depend krti hai

→ $K_H \propto$ temperature

→ solubility $\propto \frac{1}{(K_H)_g}$

→ $X_g = \frac{n_g}{n_g + n_{H_2O}}$, $X_g + X_{H_2O} = 1$






THANK YOU

MANTHAN NEET 2025

total Quest^{n} = 3

3×4 = 12M

CHEMISTRY

✓ **chemical kinetics**

Lecture-01



Sarvesh Sir

Topic Name

1. RATE
2. TYPE OF RATE
3. RATE OF REACTION

Reaction → Classification of rxn in basis of rate

Fast Reaction	Very slow Rxn	Moderate rate rxn
→ does not measure rate of very fast rxn	does not measure rate of very slow rxn	measure rate of moderate rate rxn (slow rxn)
		Reason → Change measure w.r.t. time.

RATE

→ Change in Concentration of Reactant or product per unit time.

$$\text{Rate} = \frac{\text{Change in Concentration}}{\text{time taken}} = \frac{C_f - C_i}{t_f - t_i} = \frac{\Delta C}{\Delta t}$$

Change
- → Concentration → Molarity
- → pressure (gas phase)

time
- → Sec
- → Minute
- → hour

Ex→ $A \longrightarrow B$

	A	B	
initial value of Reactant =	A_0	0	$t=0$
	(A_0-x)	x	t sec

$(A_0 - x) \downarrow$

After 't' time A_t

Con. of Reactant

$$R_A = \frac{C_f - C_i}{t_f - t_i} = \frac{A_t - A_0}{t - 0} = \frac{A_t - A_0}{t}$$

$$R_B = \frac{C_f - C_i}{t_f - t_i} = \frac{x - 0}{t - 0} = \frac{x}{t}$$

Ex → $A \longrightarrow 2B$

A_0	0	$t=0$
$A_t = (A_0 - x)$	$2x$	t sec

$$R_A = \frac{C_f - C_i}{t_f - t_i} = \frac{A_t - A_0}{t - 0} = \frac{A_0 - x - A_0}{t} = -\frac{x}{t}, \quad R_A = \ominus \frac{x}{t}$$

Represent ⇒ Con. of React-ant decreases during rxn

$$R_B = \frac{2x - 0}{t - 0} = \frac{2x}{t}, \quad R_B = \oplus \frac{2x}{t}$$

Con. of prd increases during rxn

$$R_A = -\frac{x}{t}$$

$$R_B = +\frac{2x}{t}$$

$$R_B = 2 \times R_A$$

$$\frac{R_B}{2} = \frac{R_A}{1}$$

Ex → $2A \rightarrow 3B$

$$-\frac{R_A}{2} = +\frac{R_B}{3}$$

Ex → $3A \rightarrow 5B$

Select Correct option

a) $-R_A = +R_B$

$$-\frac{R_A}{3} = +\frac{R_B}{5}$$

b) $+\frac{R_A}{3} = -\frac{R_B}{5}$

c) $-\frac{R_A}{3} = +\frac{R_B}{5}$

d) $-R_A/5 = +R_B/3$

C_{SD} → Rate = $\frac{\text{Change in Con.}}{\text{time taken}} = \frac{C_f - C_i}{t_f - t_i} = \frac{\Delta C}{\Delta t}$

Rate = $\frac{\text{mole/litre}}{\text{sec}}$ = mole·litre^{-1} sec^{-1}

→ $n_1 A + n_2 B \longrightarrow n_3 C$ (Balance)

$R.O.R = -\frac{R_A}{n_1} = -\frac{R_B}{n_2} = +\frac{R_C}{n_3}$

→ **Rate of Reaction** = Rate of Reactant or product per mole or Concentration change

$R.O.R. = \frac{R_{\text{React}^n \text{ or product}}}{\text{Stoichiometric Coefficient}}$

Example 4.2 The decomposition of N_2O_5 in CCl_4 at 318K has been studied by monitoring the concentration of N_2O_5 in the solution. Initially the concentration of N_2O_5 is 2.33 mol L^{-1} and after 184 minutes, it is reduced to 2.08 mol L^{-1}. The reaction takes place according to the equation

$$2\,N_2O_5\,(g) \rightarrow 4\,NO_2\,(g) + O_2\,(g)$$

Calculate the average rate of this reaction in terms of hours, minutes and seconds. What is the rate of production of NO_2 during this period?

Solution

Average Rate $\frac{1}{2} \quad \frac{N_2O_5}{t} \qquad \frac{1}{2}\ \frac{2.08 \quad 2.33 \ \text{mol L}^{\ 1}}{184\ \text{min}}$

$= \ 6.79 \times 10^{-4}$ mol L^{-1}/min = $(6.79 \times 10^{-4}$ mol L^{-1} $min^{-1}) \times (60$ min/1h)

$= \ 4.07 \times 10^{-2}$ mol L^{-1}/h

$= \ 6.79 \times 10^{-4}$ mol $L^{-1} \times$ 1min/60s

$= \ 1.13 \times 10^{-5}$ mol $L^{-1}s^{-1}$

It may be remembered that

$$\text{Rate} \quad \frac{1}{4} \quad \frac{NO_2}{t}$$

$$\frac{NO_2}{t} \quad 6.79 \times 10^{-4} \times 4 \text{ mol L}^{-1}\text{ min}^{-1} = 2.72 \times 10^{-3} \text{ mol L}^{-1}\text{min}^{-1}$$

$2N_2O_5 \rightarrow 4NO_2 + O_2$

2.33 → A_0 0 0 t=0

2.08 → A_t 184 minu

$R_{N_2O_5} = \frac{2.08 - 2.33}{184 - 0}$

$= -1.36 \times 10^{-3}$ mole litre × min

$R_{N_2O_5} = -1.36 \times 10^{-3}$ mole·litre^{-1} minute^{-1}

t = 184 × 60 sec

t = $\frac{184}{60}$ hour

$$-\frac{R_{N_2O_5}}{2} = +\frac{R_{NO_2}}{4}$$

$$-\frac{(-1.36\times10^{-3})}{2} = +\frac{R_{NO_2}}{4_2}$$

$$\boxed{R_{NO_2} = +1.36\times10^{-3}\times2}$$ mole·litre^{-1} minute^{-1}

Q. Initial Concentration of reactant is 0.5 mole/litre. After 10 minutes, the concentration of reactant is 0.2 mole/litre. Calculate rate of reaction.?

A_0 t A_t

(a) 3x10-2 mole/litre/minute ✓

(b) 18 x10-2 mole/litre/minute

(c) 3.0x10-1 mole/litre/minute

(d) 30x10-2 mole/litre/minute

$$R = \frac{C_f - C_i}{\text{time taken}} = \frac{0.2 - 0.5}{10 - 0} = -\frac{0.3}{10}$$

$$= -3.0 \times 10^{-2}\ \text{mole} \cdot \text{litre}^{-1}\ \text{minute}^{-1}$$

Intext Questions

4.1 For the reaction R → P, the concentration of a reactant changes from 0.03M to 0.02M in 25 minutes. Calculate the average rate of reaction using units of time both in minutes and seconds. → H.W.

4.2 In a reaction, 2A → Products, the concentration of A decreases from 0.5 mol L^{-1} to 0.4 mol L^{-1} in 10 minutes. Calculate the rate during this interval?

$2A \rightarrow$ products

0.5   0   t=0

0.4   t=10 minutes

$$R_A = \frac{0.4-0.5}{10} = -\frac{0.1}{10} = -1\times10^{-2}$$

Q A gaseous hypothetical chemical equation $2A \rightarrow 4B + C$ is carried out in a closed vessel. The concentration of B is found to increase by 5×10^{-3} mol l^{-1} in 10 second. The rate of appearance of B is:

(A) 5×10^{-4} mol l^{-1} sec^{-1}

(B) 5×10^{-5} mol l^{-1} sec^{-1}

(C) 6×10^{-5} mol l^{-1} sec^{-1}

(D) 4×10^{-4} mol l^{-1} sec^{-1}

ΔC

$$r_B = \frac{\Delta C}{\Delta t} = \frac{5 \times 10^{-3}}{10} = 5 \times 10^{-4} \text{ mole litre}^{-1} \text{ sec}^{-1}$$

Q. $3\,Br_2 + 6OH^- \rightarrow 5Br^- + BrO_3^- + 3H_2O$, rate of formation of BrO_3^- is 1.5×10^{-2} Mole litre^{-1}Sec^{-1}

$r_{BrO_3^-}$

Calculate

(1) Rate of disappearance of Br_2 $= -3 \times 1.5 \times 10^{-2}$ mole litre^{-1} sec^{-1}

(2) Rate of formation of Br^- $= +5 \times 1.5 \times 10^{-2}$

(3) Rate of disppearance of OH^- $= -6 \times 1.5 \times 10^{-2}$

The rate of a reaction is expressed in different ways as follows:

$$+\frac{1}{2}\frac{d[C]}{dt} = -\frac{1}{3}\frac{d[D]}{dt} = +\frac{1}{4}\frac{d[A]}{dt} = -\frac{d[B]}{dt}$$

The reaction is:

(A) $4A + B \longrightarrow 2C + 3D$

(B) $B + 3D \longrightarrow 4A + 2C$

(C) $4A + 2B \longrightarrow 2C + 3D$

(D) $B + (1/2)D \longrightarrow 4A + B$

$$+\frac{r_C}{2} = -\frac{r_D}{3} = +\frac{r_A}{4} = -\frac{r_B}{1}$$

$$1B + 3D \rightarrow 2C + 4A$$

Q. For the reaction $2A + 3B + \frac{3}{2}C \rightarrow 3P$, which statement is correct?

[JEE Main 2020- 3 September (evening)]

a) $\left(\frac{dn_A}{dt}\right) = \frac{3}{2}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$

b) $\left(\frac{dn_A}{dt}\right) = \frac{dn_B}{dt} = \frac{dn_C}{dt}$

c) $\left(\frac{dn_A}{dt}\right) = \frac{2}{3}\frac{dn_B}{dt} = \frac{4}{3}\frac{dn_C}{dt}$

d) $\left(\frac{dn_A}{dt}\right) = \frac{2}{3}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$

NEET-2025 - - -

$$\frac{r_A}{2} = \frac{r_B}{3} = \frac{r_C}{\frac{3}{2}} = \frac{r_P}{3}$$

$$\frac{r_A}{2} = \frac{r_B}{3} = \frac{2r_C}{3} = \frac{r_P}{3}$$

$$r_A = \frac{2r_B}{3} = \frac{4r_C}{3} = \frac{2r_P}{3}$$

Q13. For the reaction, $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$.

The value of rate of disappearance of N_2O_5 is given as 6.25×10^{-3} mol L^{-1} s^{-1}. The rate of formation of NO_2 and O_2 is given respectively as

[CBSE AIPMT 2010]

(a) 6.25×10^{-3} mol L^{-1} s^{-1} and 6.25×10^{-3} mol L^{-1} s^{-1}

(b) 1.25×10^{-2} mol L^{-1} s^{-1} and 3.125×10^{-3} mol L^{-1} s^{-1}

(c) 6.25×10^{-3} mol L^{-1} s^{-1} and 3.125×10^{-3} mol L^{-1} s^{-1}

(d) 1.25×10^{-2} mol L^{-1} s^{-1} and 6.25×10^{-3} mol L^{-1} s^{-1}

$$-\frac{r_{N_2O_5}}{1} = +\frac{r_{NO_2}}{2}$$

$$r_{NO_2} = 2 \times r_{N_2O_5}$$

Q16. In the reaction, $BrO_3^-(aq) + 5Br^-(aq) + 6H^+ \rightarrow 3Br_2(l) + 3H_2O(l)$
the rate of appearance of bromine (Br_2) is related to rate of disappearance of bromide ions as following?

[CBSE AIPMT 2000]

(a) $\frac{d[Br_2]}{dt} = -\frac{3}{5}\frac{d[Br^-]}{dt}$ ✓

(b) $\frac{d[Br_2]}{dt} = -\frac{5}{3}\frac{d[Br^-]}{dt}$ ✗

(c) $\frac{d[Br_2]}{dt} = \frac{5}{3}\frac{d[Br^-]}{dt}$ ✗

(d) $\frac{d[Br_2]}{dt} = \frac{3}{5}\frac{d[Br^-]}{dt}$ ✗

$$+\frac{r_{Br_2}}{3} = -\frac{r_{Br^-}}{5}$$

$$r_{Br_2} = -\frac{3}{5} r_{Br^-}$$

Q17. For the reaction, $N_2 + 3H_2 \rightarrow 2NH_3$, if $\frac{d[NH_3]}{dt} = 2\times 10^{-4}$ mol L^{-1} s^{-1}, the value of $-\frac{d[H_2]}{dt}$ would be

[CBSE AIPMT 2009]

(a) 3×10^{-4} mol L^{-1} s^{-1}
(b) 4×10^{-4} mol L^{-1} s^{-1}
(c) 6×10^{-4} mol L^{-1} s^{-1}
(d) 1×10^{-4} mol L^{-1} s^{-1}

$$-\frac{r_{H_2}}{3} = +\frac{r_{NH_3}}{2}$$

$$r_{H_2} = -\frac{3}{2} r_{NH_3} = -\frac{3}{2} \times 2 \times 10^{-4} = -3 \times 10^{-4}$$

RATE OF REACTION

$$2A \longrightarrow 3B$$

	A_0	0	$t=0$
$A_t =$	$(A_0 - 2x)$	$3x$	t sec

$$R_A = \frac{A_t - A_0}{t} = \frac{A_0 - 2x - A_0}{t}$$

$$\boxed{R_A = -\frac{2x}{t}}$$

$$R_B = \frac{3x - 0}{t - 0} = +\frac{3x}{t}$$

$$\boxed{R_B = +\frac{3x}{t}}$$

$$\text{Rate of rxn} = \boxed{-\frac{R_A}{2}} = +\boxed{\frac{R_B}{3}}$$

$$R.O.R. = -\frac{2x}{2t} = +\frac{3x}{3t} = \frac{x}{t}$$

Q $2A + B \rightarrow 3C$

In 10 Sec. Con. of Reactant 'A' change 0.8 M to 0.6 M

Select Correct option

$R_A = \frac{0.6-0.8}{10} = \frac{-0.2}{10} = -2\times10^{-2}$

a) $R_A = -2\times10^{-2}$

b) $R_B = -1\times10^{-2}$

$R.O.R = \frac{R_A}{2} = \frac{2\times10^{-2}}{2} = 1\times10^{-2}$

c) $R_C = +3\times10^{-2}$

d) $R.O.R. = 1\times10^{-2}$

e) All Correct

33. Consider the chemical reaction, $N2(g) + 3H_2(g) \rightarrow 2NH_3(g)$. The rate of this reaction can be expressed in terms of time derivatives of concentration of N_2(g), H_2(g) or NH_3(g). Identify the correct relationship amongst the rate expressions [2002, 3M]

(a) $Rate = -\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

(b) $Rate = -\frac{d[N_2]}{dt} = -3\frac{d[H_2]}{dt} = 2\frac{d[NH_3]}{dt}$

(c) $Rate = \frac{d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

(d) $Rate = -\frac{d[N_2]}{dt} = -\frac{d[H_2]}{dt} = \frac{d[NH_3]}{dt}$

$R.O.R = -\frac{r_{N_2}}{1} = -\frac{r_{H_2}}{3} = +\frac{r_{NH_3}}{2}$

Solution:

Q25. Consider the reaction, $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$. The equality relationship between $\frac{d[NH_3]}{dt}$ and $-\frac{d[H_2]}{dt}$ is

H.W.

[CBSE AIPMT 2006]

(a) $\frac{d[NH_3]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt}$

(b) $+\frac{d[NH_3]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt}$

(c) $+\frac{d[NH_3]}{dt} = -\frac{3}{2}\frac{d[H_2]}{dt}$

(d) $\frac{d[NH_3]}{dt} = -\frac{d[H_2]}{dt}$

Q26. For the reaction, $2A + B \rightarrow 3C + D$, which of the following does not express the reaction rate?

[CBSE AIPMT 2006]

H.W

(a) $-\frac{d[C]}{3dt}$

(b) $-\frac{d[B]}{dt}$

(c) $\frac{d[D]}{dt}$

(d) $-\frac{d[A]}{2dt}$

Q35. 3A → 2B, rate of reaction $+\frac{d[B]}{dt}$ is equal to

[CBSE AIPMT 2002]

H.W

(a) $-\frac{3}{2}\frac{d[A]}{dt}$

(b) $-\frac{2}{3}\frac{d[A]}{dt}$

(c) $-\frac{1}{3}\frac{d[A]}{dt}$

(d) $+2\frac{d[A]}{dt}$


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CHEMISTRY

chemical kinetics

Qsd

Lecture-02



Sarvesh Sir

Topic Name

1. RATE
2. TYPE OF RATE
3. RATE OF REACTION

Qsd -1. 5A → 2B, rate of reaction $+\frac{d[B]}{dt}$ is equal to

(a) $+\frac{5}{2}\frac{d[A]}{dt}$

(b) $+\frac{2}{5}\frac{d[A]}{dt}$ ✓

(c) $+5\frac{d[A]}{dt}$

(d) $+2\frac{d[A]}{dt}$

$$-\frac{r_A}{5} = +\frac{r_B}{2}$$

$$r_B = +\frac{2}{5} r_A$$

Qsd-2 $\quad +\frac{r_A}{2} = -\frac{r_B}{3} = -\frac{r_C}{5}$

select the rxn $\quad 3B + 5C \longrightarrow 2A$

a) $2A \rightarrow 3B + 5C$

b) $3B + 5C \rightarrow 2A$ ✓

c) $A \rightarrow B$

d) NONE

$\frac{?}{2}$

DIIFERENT YPE OF RATE

Rate

- **Average Rate** → $R_{avg} = \frac{\Delta c}{\Delta t} = \frac{c_f - c_i}{t_f - t_i}$

  measure at very large time interval

- **Instantaneous Rate** → $R_{inst} = \frac{dc}{dt}$ = slope of Curve

  measure at very very small time interval

$A \rightarrow B$

$$R_{avg} = \frac{C_f - C_i}{t_f - t_i} = \frac{20-4}{102-2} = \frac{16}{100}$$

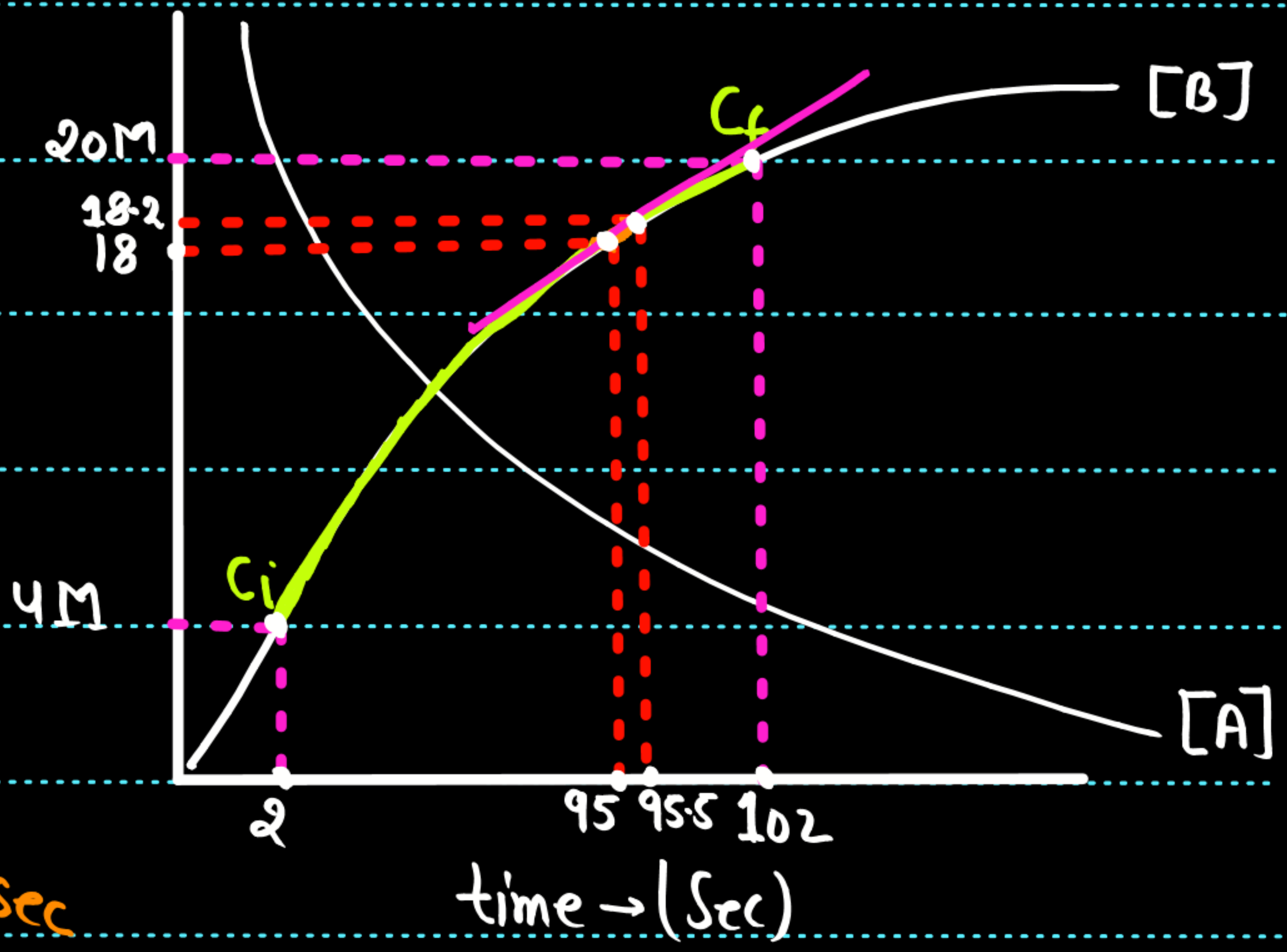
$$R_{avg} = 0.16 \text{ M/sec}$$

↑ Con

$$R_{inst} = \frac{dc}{dt} = \frac{18.2-18}{95.5-95}$$

↓ Slope of Curve

$$= \frac{0.2}{0.5} = \frac{2}{5} = 0.4 \text{ M/sec}$$



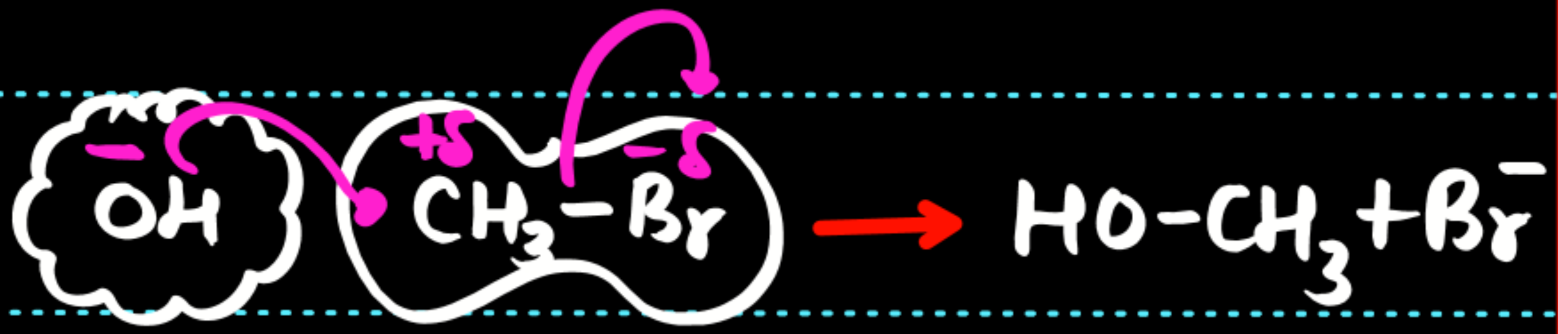
Classification of Reaction in basis of No. of step

Used in Complete chemical Reaction

Reaction

Elementry Rxn	Complex Rxn
→ Rxn complete singlestep (onestep)	→ Complete more than one step (more than
Ex → S_N2	1)
	Ex – S_N1

Ex → $CH_3-Br + OH^- \rightarrow CH_3OH + Br^-$

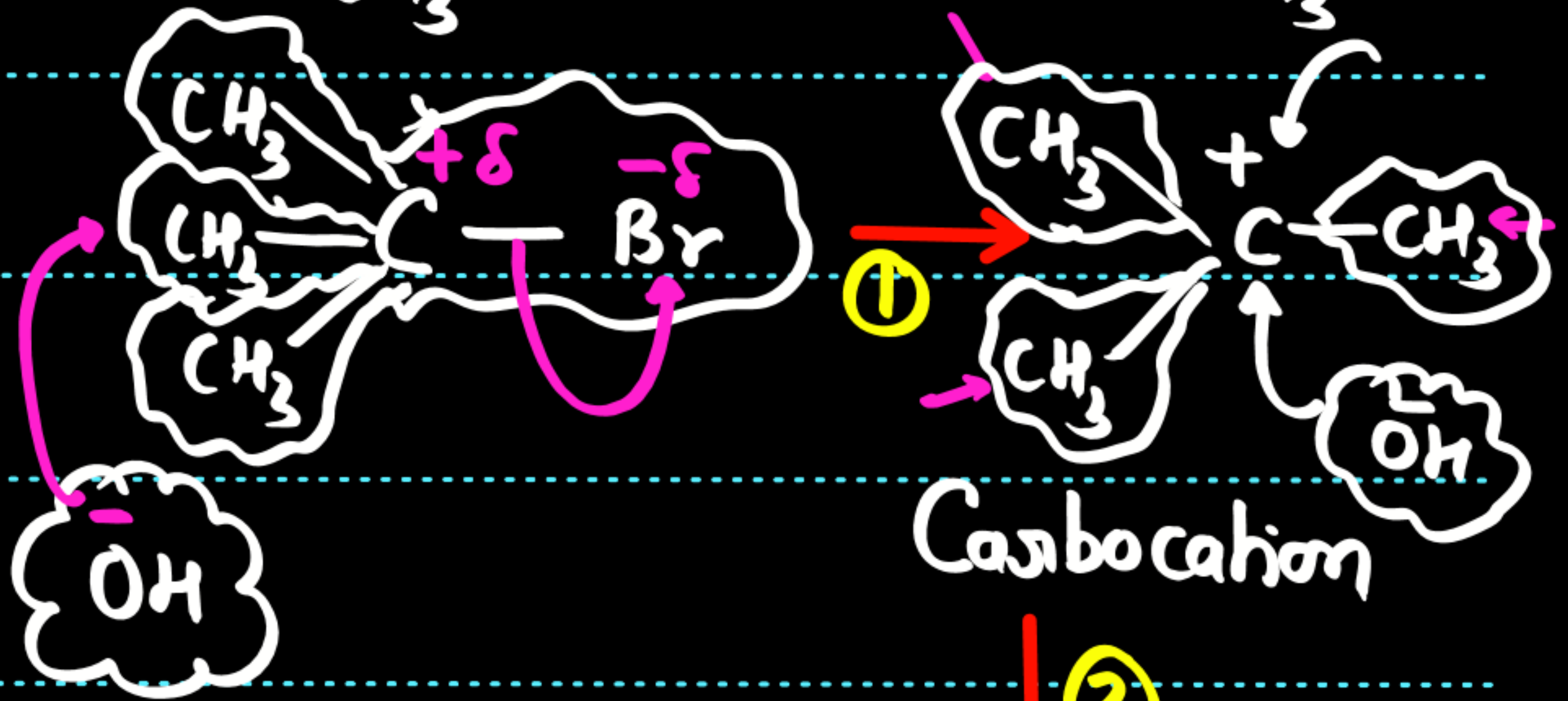


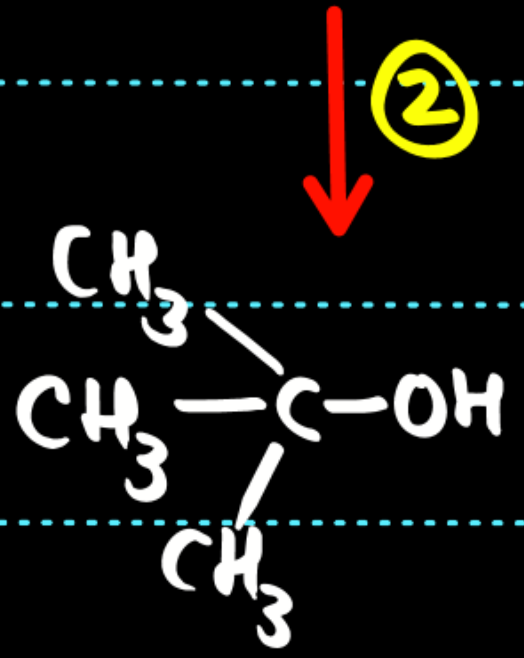
Step = 1

→ elementry Rxn

→ S_N2 Rxn

Ex $(CH_3)_3C-Br + OH^- \rightarrow (CH_3)_3C-OH$





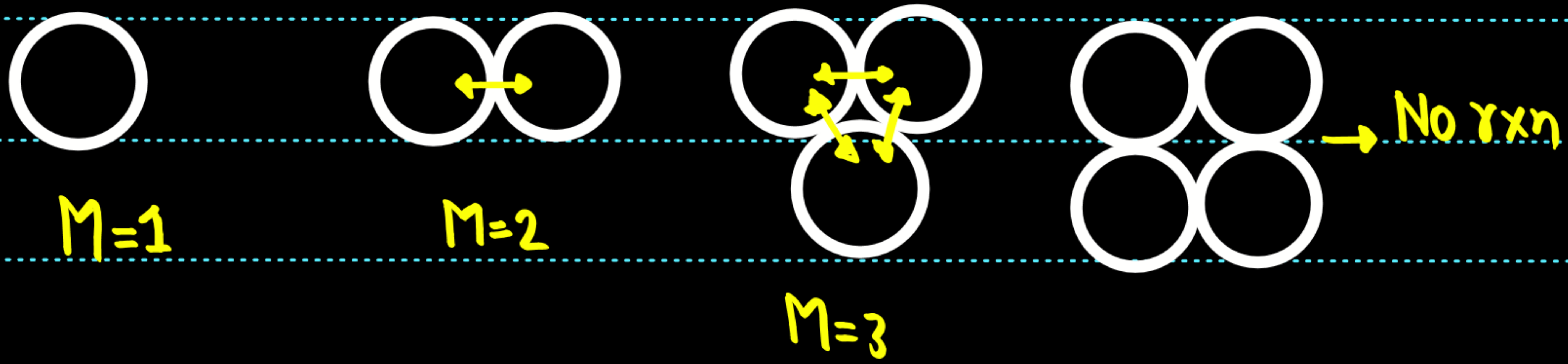
→ Complex Rxn

→ More than one step → S_N1

Molecularity

→ Suppose → Rxn occurs due to collision

total No. of species colloids sumeltaneously in a elementry Rxn is known as molecularity of Rxn.



- Elementry rxn
- M = 1, 2, 3
- M ≠ 0, M > 3 → X
- M ≠ fractional
- theoretical quantity
- Complex rxn → not define

→ sum of Stoichiometric coefficient of reactant in balance Elementry rxn

$A + B \rightarrow C$

$M = 1 + 1 = 2$

Ex → $2A + B \rightarrow C$

$M = 2 + 1 = 3$

Q→ $2A \longrightarrow B$ is a example of elementry rxn. Select Correct statements/option

a) M = 1   M = 2

b) M = 2

c) M = 3

d) Can not calculate

Q→ $2A \longrightarrow B$ is a example of Complex rxn. Select Correct statements/option

a) M = 1

b) M = 2

c) M = 3

d) Can not calculate

Order of Reaction

Rate of reaction $\propto$ [Con. of Reactant After 't' time]^n

$$A \longrightarrow B$$

A_0	0	$t=0$
$A_t = (A_0 - x)$	x	t sec

$$\text{Rate} \propto [A_t]^n$$

$$\boxed{\text{Rate} = K\,[A_t]^n}$$

Where → K = Rate Constant

K depend upon → 1) temperature
2) nature of Rxn

n = order of reaction

13:3

$n_1 A + n_2 B \longrightarrow n_3 C$

$Rate = K[A_t]^x [B]^y$ — Rate law expression Eq.
(Experimental Eq.)

Note → $x = n_1$ or $x \neq n_1$

$y = n_2$ or $y \neq n_2$

Q → $2A + B \longrightarrow 3C$

select possible Rate law Expression Eq. of above rxn.

a) $R = K[A]^2$

b) $R = K[A][B]^{1/2}$

c) $R = K[A]^2[B]^1$

~~d)~~ Can not Calulate

Sum of power of Concentration of Reactant in Rate law Expression Equation is Known as order of Reaction

Ex→ $2A + B \rightarrow 5C$

$R = K[A]^{x}[B]^{y}$ → Exp. Eq

→ order of rxn $= x + y$

1) Exp. quantity

Ex→ $3A \rightarrow 2B$

$R = K[A]^{3/2}$

find out order of rxn

a) 3 b) 2

c) 3/2 d) 2/3

Example 4.3 Calculate the overall order of a reaction which has the rate expression

(a) Rate = $k\,[A]^{1/2}\,[B]^{3/2}$ → $\frac{1}{2}+\frac{3}{2}=\frac{4}{2}=2$

(b) Rate = $k\,[A]^{3/2}\,[B]^{-1}$ → $\frac{3}{2}-1=\frac{3-2}{2}=\frac{1}{2}=0.5$

Solution

(a) Rate = $k\,[A]^{x}\,[B]^{y}$

order = x + y

So order = 1/2 + 3/2 = 2, i.e., second order

(b) order = 3/2 + (–1) = 1/2, i.e., half order.

4.2.4 Molecularity of a Reaction

Another property of a reaction called molecularity helps in understanding its mechanism. The number of reacting species (atoms, ions or molecules) taking part in an elementary reaction, which must collide simultaneously in order to bring about a chemical reaction is called molecularity of a reaction. The reaction can be unimolecular when one reacting species is involved, for example, decomposition of ammonium nitrite.

Intext Questions

4.3 For a reaction, A + B $\rightarrow$ Product; the rate law is given by, $r = k[A]^{1/2}[B]^2$. What is the order of the reaction?

$\rightarrow \frac{1}{2} + 2 = \frac{1+4}{2} = \frac{5}{2}$

4.4 The conversion of molecules X to Y follows second order kinetics. If concentration of X is increased to three times how will it affect the rate of formation of Y ?

$X \rightarrow Y \Rightarrow R = K[X]^2 \rightarrow R = K[3X]^2 = 3^2 K[X]^2$

$R.O.R = \frac{r_X}{1} = \frac{r_Y}{1} = r_X = r_Y$ $\quad R_N = 9 \times R_{old}$

$$2A + 3B \rightarrow 5C$$

$$R.O.R = \frac{r_A}{2} = \frac{r_B}{3} = \frac{r_C}{5}$$

$$_X \longrightarrow _Y$$

$$\rightarrow R.O.R. = r_X = r_Y$$

$$R.O.R = K[X]^2 \Rightarrow R_N = K[3X]^2 = 3^2 K[X]^2 = 9 \times K[X]^2 = 9 \times R_{old}$$

$$r_Y = K[X]^2 \qquad (r_Y)_N = 9 \times (r_Y)_{old}$$

CSD

Molecularity	Order of Reaction
→ sum of Sto. ceofficient of Reactant species in elementry rxn	→ sum of power of Reactant Con. in Rate law expression
$2A + B \longrightarrow 5C$	$n_1 A + n_2 B \longrightarrow n_3 C$
$M = 2+1 = 3$	$R = K[A]^x[B]^y \Rightarrow O.R. = x+y$
→ $M = 1, 2, 3,$ Max $M = 3$	→ O.R. = zero, frachonal, negative
→ $M \neq 0$, $M \neq$ frachonal, $M \neq$ negative	$(O.R.)_{max} = 3$
→ theorehical quantity	→ Experimental quantity

CSD

Molecularity	Order of Reaction
→ Elementry Rxn → only define hai	→ both elementry & Complex rxn = define hai
	→ $x = n_1$ or $x \neq n_1$
	→ $y = n_2$ or $y \neq n_2$

Note ⇒ for elementry rxn ⇒ M = order of rxn (sum of sto. ceofficient of Reactant)

Q→ $A + B \rightarrow P$ example of elementry rxn, select correct option

a) O.R. = 1

b) ✓✓ O.R. = 2

c) O.R. = $\frac{1}{2}$

d) O.R. is Experimental quantity so can not calculate

Q→ $A + B \rightarrow P$ example of Complex rxn, select correct option

a) O.R. = 1

b) O.R. = 2

c) O.R. = $\frac{1}{2}$

d) ✓✓ O.R. is Experimental quantity so can not calculate


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MANTHAN NEET 2025

CHEMISTRY

chemical kinetics

Lecture-03



Sarvesh Sir

Topic Name

1. RATE
2. TYPE OF RATE
3. RATE OF REACTION

Qsd-1 $2A + B \longrightarrow P \rightarrow \times$

$$R = K[A]^{3/2}$$

order of rxn is

a) 2

b) 3

c) 3/2

d) 1

Qsd-2 $A + B \rightarrow P$

$1+1=2$

is a example of elementry rxn

$\frac{?}{2}$

a) O.R. = 2, M = 2

b) M = 2, O.R = 1

c) O.R. Can not calculate

d) M = 2, O.R. = 1

Elementry → O.R. = M = sum of sto. ceofficient

Detemination of order of Reaction

1) Unit of K (Rate Constant)

$A \rightarrow B$

$R = K[A_t]^n$ → n → order of rxn

$$K = \frac{Rate}{[A_t]^n} = \frac{(\Delta c/\Delta t)}{[A_t]^n}$$

$$K = \frac{[\Delta c]}{[A_t]^n \times \Delta t}$$

$$K = \frac{[Con.]}{[Con.]^n \times time}$$

***

$$\boxed{K = [Con]^{1-n} \times time^{-1}}$$

$$= \left(\frac{Mole}{litre}\right)^{1-n} \times Sec^{-1}$$

yaad Rakhna

$[\text{Mole}/\text{Litre}]^{1-n} \times \text{Sec}^{-1}$

n = order of Reaction

- Zero order rxn ($n=0$) → $K = \frac{\text{mole}}{\text{litre}} \times \text{sec}^{-1}$
- 1^{st} order ($n=1$) → $K = \text{Sec}^{-1}$
- 2^{nd} order ($n=2$) → $\left(\frac{\text{mole}}{\text{litre}}\right)^{-1} \times \text{sec}^{-1}$ or $\text{mole}^{-1} \cdot \text{litre} \times \text{sec}^{-1}$
- $n=-1$ → $\text{Mole}^{2} \cdot \text{litre}^{-2} \times \text{Sec}^{-1}$

Q → $2A + 3B \rightarrow 5C$

Rate Constant of above rxn is $1.2 \times 10^{3}\ Sec^{-1}$

and value of A & B After 10 Sec is 0.2M & 0.4M respectively

Calculate order of rxn

a) zero

b) 1st

c) 2nd

d) O.R. = -1

$K = [Con.]^{1-n} \times time^{-1}$

$n = 1$

$K = time^{-1}$

Identify the reaction order from each of the following rate constants. (Example 4.4)

(i) $k = 2.3 \times 10^{-5}$ L mol^{-1} s^{-1} → $n=2$

(ii) $k = 3 \times 10^{-4}$ s^{-1} → $n=1$

Solution

(i) The unit of second order rate constant is L mol^{-1} s^{-1}, therefore $k = 2.3 \times 10^{-5}$ L mol^{-1} s^{-1} represents a second order reaction.

(ii) The unit of a first order rate constant is s^{-1} therefore $k = 3 \times 10^{-4}$ s^{-1} represents a first order reaction.

(i) $K = \left[\frac{\text{mole}}{\text{litre}}\right]^{1-n} \times \text{sec}^{-1}$ (ii) $n=1$

$n=+2$

$K = \left(\frac{\text{mole}}{\text{litre}}\right)^{-1} \times \text{sec}^{-1}$

$\text{mole}^{-1} \times \text{litre} \times \text{sec}^{-1}$

2) Given Relation between Con. of Reactant & Rate of rxn.

$A \rightarrow B$

$R_{old} = K[A_t]^n$

Suppose → Con. increases 'x' time

$R_N = K[xA_t]^n$

$R_N = Kx^n[A_t]^n = x^n \boxed{K[A_t]^n}$

$\boxed{R_N = x^n \cdot R_{old}}$

CSD 1) Unit of $K = [\text{Con}]^{1-n} \times \text{time}^{-1}$

where → n = order of rxn

2) $A \longrightarrow B$

Suppose → Con. of Reactant change 'x' time

$$R_{New} = x^n \cdot R_{old}$$

where → n = order of rxn
x = change in Con.

a) $n = 0$ (zero order rxn)

$$R_{New} = R_{old}$$

b) $n = 1$ (1st order)

$$R_{New} = x \times R_{old}$$

c) $n = 2$ (2nd order)

$$R_{New} = x^2 \cdot R_{old}$$

d) $n = 3$ (3rd order)

$$R_{New} = x^3 \cdot R_{old}$$

e) $n = -1$

$$R_{New} = \frac{1}{x} \times R_{old}$$

The rate of a gaseous reaction is given by the expression k[A][B], if the volume of the reaction vessel is suddenly reduced to 1/4th of the initial volume, the reaction rate relating to original rate will be:

(A) 1/10

(B) 1/8

(C) 8

(D) 16

Con = 4 time

order = 1+1 = 2

$4^2 = 16$

↑ Con = $\frac{\text{mole}}{\text{litre}}$ ↓

$\frac{\text{Mole}}{\frac{1}{4}V}$

$= 4 \times \left(\frac{\text{mole}}{V}\right)$

Units of rate constant

For a general reaction

$$aA + bB \rightarrow cC + dD$$

$$\text{Rate} = k\,[A]^x\;[B]^y$$

Where x + y = n = order of the reaction

$$k = \frac{\text{Rate}}{[A]^x[B]^y}$$

$$= \frac{\text{concentration}}{\text{time}} \times \frac{1}{\text{concentration}^{\,n}} \qquad \text{where } [A]\;\;[B]$$

Taking SI units of concentration, mol L^{-1} and time, s, the units of k for different reaction order are listed in Table 4.3

Table 4.3: Units of rate constant

Reaction	Order	Units of rate constant
Zero order reaction	0	$\frac{mol\,L^{1}}{s}\;\;\frac{1}{mol\,L^{1\;0}}\;\;mol\,L^{1}s^{1}$
First order reaction	1	$\frac{mol\,L^{1}}{s}\;\;\frac{1}{mol\,L^{1\;1}}\;\;s^{1}$
Second order reaction	2	$\frac{mol\,L^{1}}{s}\;\;\frac{1}{mol\,L^{1\;2}}\;\;mol^{1}L\,s^{1}$

Q

$2A \longrightarrow B + C$

$-\frac{dA}{dt} = K[A_t]^1$. If concentration of 'A' is double. Than the rate of reaction is x times of initial rate, the value of x is:

(A) 1

(B) 2

(C) 3

(D) 1.5

x time

x time

x = 2

8. For the reaction, 2A + B → C, the values of initial rate at different reactant concentrations are given in the table below. The rate law for the reaction is

[2019 Main, 8 April I]

[A](mol L^{-1})	[B](mol L^{-1})	Initial rate (mol $L^{-1}s^{-1}$)
0.05	0.05	0.045
0.10	0.05	0.090
0.20	0.10	0.72

NEET-2025

(a) rate = k [A] $[B]^2$

(b) rate = k $[A]^2[B]^2$

(c) rate = k [A] [B]

(d) rate = $[A]^2[B]$

Solution: 12th → (M-1)

$R = k[A_t]^x[B_t]^y$

$0.045 = k[0.05]^x[0.05]^y$ — 1

$0.090 = k[0.10]^x[0.05]^y$ — 2

$0.72 = k[0.20]^x[0.10]^y$ — 3

$\left(\frac{1}{2}\right) \Rightarrow \frac{0.045}{0.090} = \frac{(0.05)^x}{(0.10)^x}$

$\frac{1}{2} = \left(\frac{0.05}{0.10}\right)^x$

$\left(\frac{1}{2}\right)^1 = \left(\frac{1}{2}\right)^x$

$x = 1$

Q5. $2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(s)$

This reaction was studied at -10°C and the following data was obtained

run	$[NO]_0$	$[Cl_2]_0$	r_0
1	0.10	0.10	0.18
2	0.10	0.20	0.35
3	0.20	0.20	1.40

$[NO]_0$ and $[Cl_2]_0$ are the initial concentrations and r_0 is the initial reaction rate. The overall order of the reaction is 3.

(Round off to the Nearest Integer).

$R = K[NO]^x[Cl_2]^y$, $y = 1$, $x = 2$

order $= x + y = 2 + 1 = 3$

NCERT Exercise

[18 March (Shift 1) 2021]

15. For the reaction $2A + B \rightarrow$ Products When concentration of both (A and B) becomes double, then rate of reaction increases from 0.3 mol L^{-1} s^{-1} to 2.4 mol L^{-1} S^{-1}. When concentration of only A is doubled, the rate of reaction increases from 0.3 mol L^{-1} S^{-1} to 0.6 mol L^{-1} S^{-1}. Which of the following is true ?

$2 \times A^1 + 2 \times B^2 = 8 \times$ time $= 2 \times 4$

$2 \times A \longrightarrow 2 \times$ time

(a) The whole reaction is of 4^{th} order

(b) The order of reaction w.r.t B is one

(c) The order of reaction w.r.t B is 2

(d) The order of reaction w.r.t A is 2

Solution:

$R = K[A]^1[B]^2 = 1 + 2 = 3$

$\text{Rate} = \frac{\Delta C}{\Delta t}$

$= \frac{\text{mole}/\text{litre}}{\text{time}}$

$= \text{mole} \times \text{litre}^{-1} \times \text{time}^{-1}$

ZERO ORDER REACTION $(n=0)$

$$A \longrightarrow B$$

$A_0 \quad 0 \quad t=0$

$A_t \rightarrow (A_0 - x) \quad x \quad t\,sec$

$$R.O.R. = R = K[A_t]^n$$

$$R = K[A_t]^0 = K$$

→ $\boxed{Rate = K}$

$$R.O.R. = \boxed{-\frac{1}{1}\frac{dA}{dt}} = \boxed{+\frac{1}{1}\frac{dB}{dt}}$$

$$-\frac{dA}{dt} = K \Rightarrow -dA = K\,dt$$

$$\int_{A_0}^{A_t} -dA = K\int_0^t dt$$

$$-[A]_{A_0}^{A_t} = K[t]_{t=0}^{t}$$

$$-[A_t - A_0] = K(t-0)$$

$$A_0 - A_t = Kt$$

$$K = \frac{A_0 - A_t}{t}$$

$$K = \frac{A_0 - (A_0 - x)}{t}$$

$$k = \frac{x}{t}$$

Half life Period $(t_{\frac{1}{2}})$

CSD ⇒ ZERO Order

→ $\boxed{Rate = K}$

→ Rate of zero order is Const. and equal to K, does not depend upon. Con of Reactant

→ $$\boxed{K = \frac{A_0 - A_t}{t} = \frac{x}{t}}$$

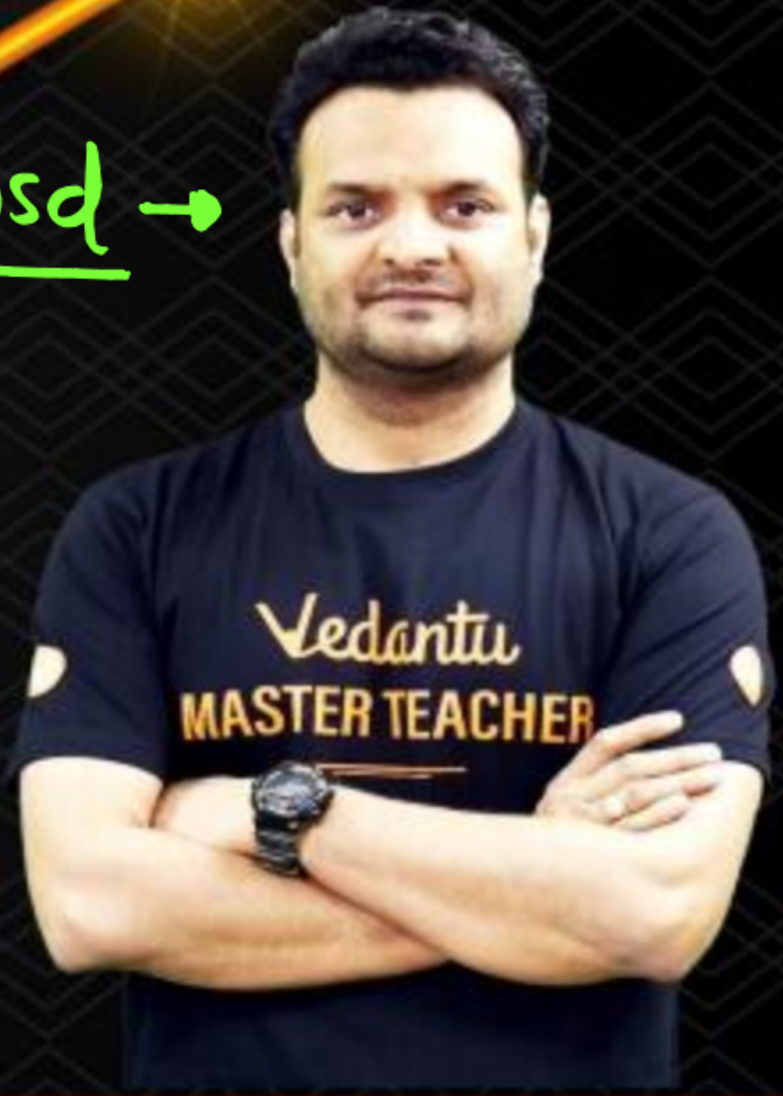

THANK
YOU

MANTHAN NEET 2025

CHEMISTRY

chemical kinetics

Lecture-04



Sarvesh Sir

Topic Name

1. RATE
2. TYPE OF RATE
3. RATE OF REACTION

Qsd-1 $A \longrightarrow B$

$[A]^0$	Rate
0.04	2×10^{-5}
0.08	2×10^{-5}

2x

Calculate Rate law

✗ a) $R = K[A]$

✗ b) $R = K[A]^{\frac{1}{2}}$

✗ c) $R = K[A]^2$

✓ d) $R = K[A]^0 \Rightarrow R = K$

13:3

Qsd-2 $A + 2B \rightarrow 5C$

the rate Constant of above rxn is 1.75×10^{2} mole·litre^{-1} sec^{-1} (K)

Select Correct Statements

a) $R = K[A]^1[B]^2$

b) order of rxn = 1

c) ✓ order of rxn = zero

d) Can not calculate order of rxn

$\frac{?}{2}$

$K = [\text{mole/litre}]^{1-n} \sec^{-1}$

$n = 0 \rightarrow \left[\frac{\text{mole}}{\text{litre}}\right]^1 \times \sec^{-1}$

mole·litre^{-1} × sec^{-1}

ZERO ORDER REACTION ($n=0$)

$$A \longrightarrow B$$

A_0	0	$t=0$
$A_t \rightarrow (A_0 - x)$	x	t sec

$$R.O.R. = R = K[A_t]^n$$

$$R = K[A_t]^0 = K$$

$\rightarrow$ $\boxed{Rate = K}$

$$R.O.R. = \boxed{-\frac{1}{1}\frac{dA}{dt}} = \boxed{+\frac{1}{1}\frac{dB}{dt}}$$

$$-\frac{dA}{dt} = K \Rightarrow -dA = K\,dt$$

$$\int_{A_0}^{A_t} -dA = K\int_0^t dt$$

$$-[A]_{A_0}^{A_t} = K[t]_{t=0}^{t}$$

$$-[A_t - A_0] = K(t-0)$$

$$A_0 - A_t = Kt$$

***

$$K = \frac{A_0 - A_t}{t}$$

$$K = \frac{A_0 - (A_0 - x)}{t}$$

$$k = \frac{x}{t}$$

Half life Period $(t_{\frac{1}{2}})$

total time required to Complete 50% or half of Reaction.

$$_A \longrightarrow _B$$

A_0	0	$t=0$
$A_t = \frac{A_0}{2} \Rightarrow \left(A_0 - \frac{A_0}{2}\right)$	$\frac{A_0}{2}$	$t_{\frac{1}{2}}$

$$K = \frac{A_0 - A_t}{t} = \frac{x}{t} = \frac{A_0}{2 \times t_{\frac{1}{2}}}$$

$t \to t_{\frac{1}{2}}, x = A_0/2$

$$K = \frac{A_0}{2 \times t_{\frac{1}{2}}}$$

$$t_{\frac{1}{2}} = \frac{A_0}{2K}$$

Q $A + 2B \rightarrow 5C$

$$Rate = K[B]^0[A]^0 = K$$

If half life period of above rxn is 10minute, total total time required to Complete 100% rxn.

a) 10minute

b) 20minute ✓

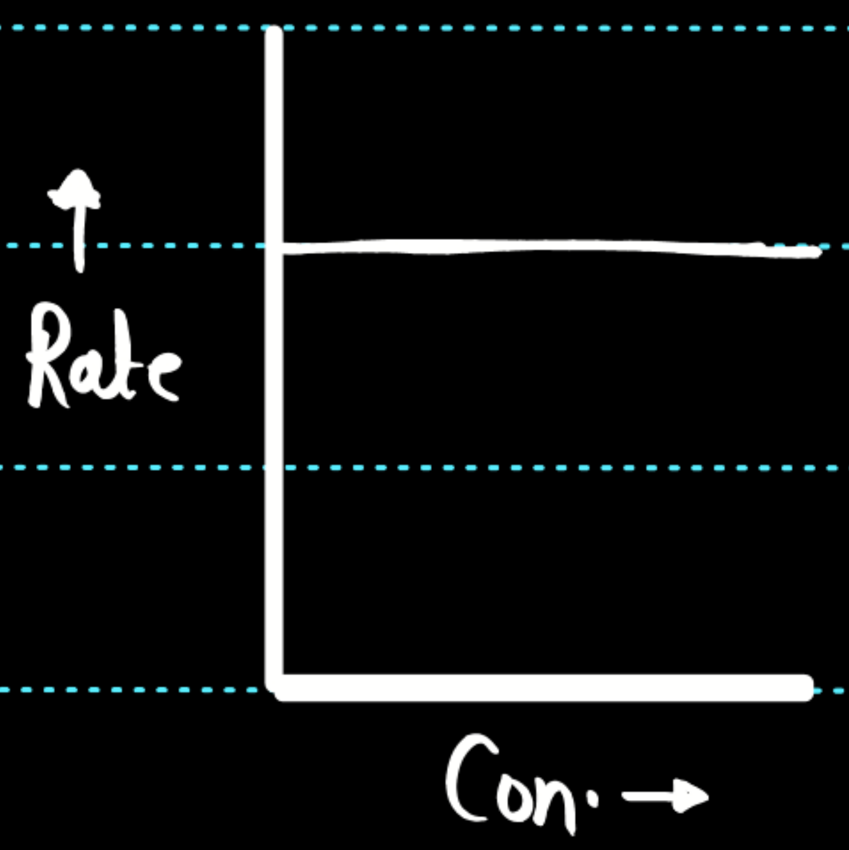
c) infinite time

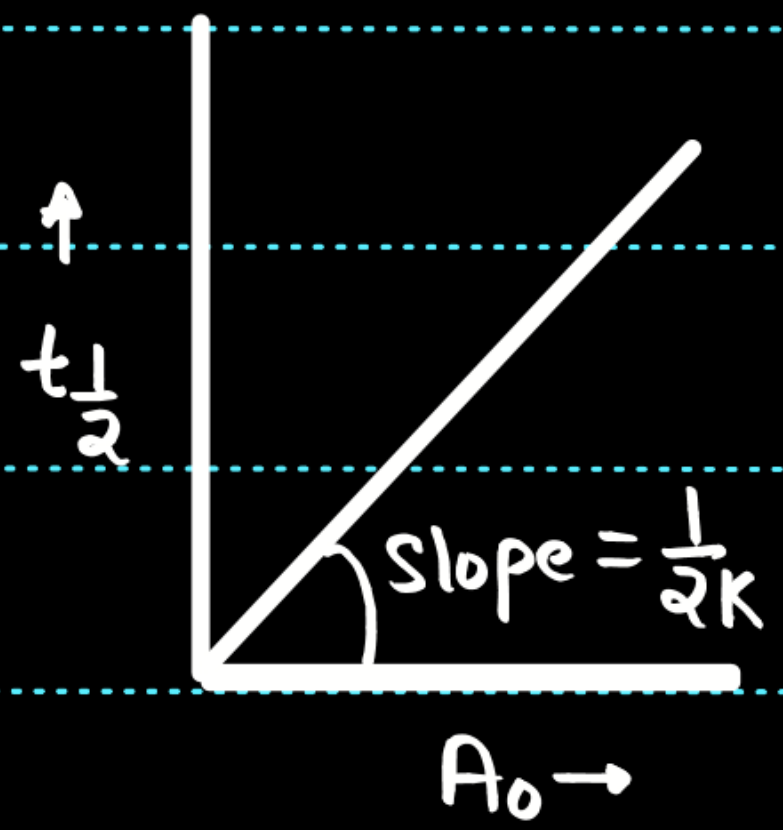
d) Can not calculate

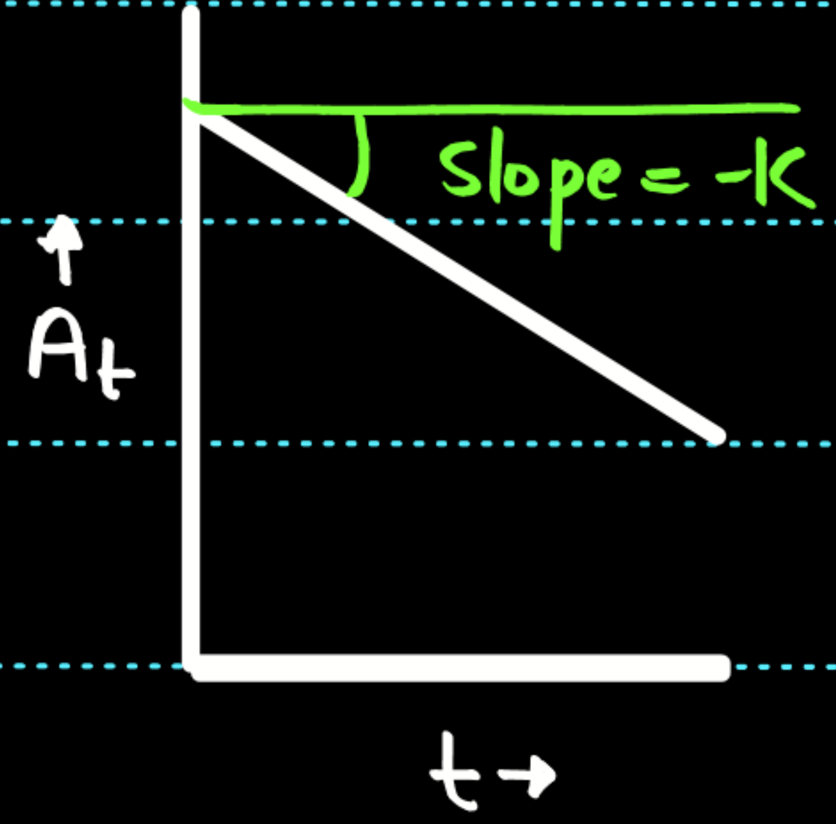
$$T_{100\%} = 2 \times t_{50\%} = 2 \times 10$$

$$= 20 \text{minute}$$

Graph of ZERO ORDER REACTION







Rate = K

$$t_{\frac{1}{2}} = \frac{A_0}{2K} = \frac{1}{2K} \times A_0$$

$$y = m\,x$$

$$K = \frac{A_0 - A_t}{t}$$

$$A_t = -Kt + A_0$$

$$y = -mx + c$$

CSD ⇒ ZERO Order

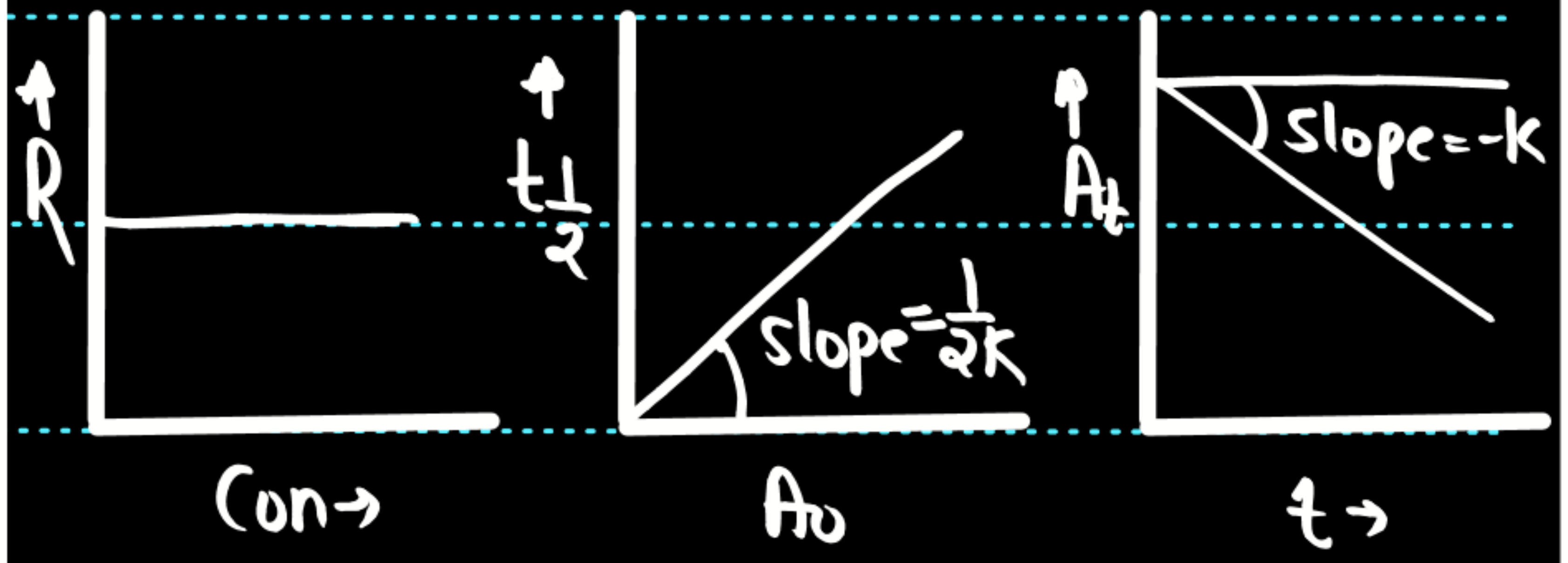
→ $Rate = K$

→ Rate of zero order is Const. and equal to K, does not depend upon Con. of Reactant

→ $K = \frac{A_0 - A_t}{t} = \frac{x}{t}$

→ $t_{\frac{1}{2}} = \frac{A_0}{2K}$

→ $T_{100\%} = 2 \times t_{\frac{1}{2}} = 2 \times \frac{A_0}{2K} \Rightarrow T_{100} = \frac{A_0}{K}$



Q $2A \longrightarrow B + C$ is a example of zero order reaction. t_1 and t_2 is the half-life period at initial concentration at A is 0.80 mole litre and 0.40 mole litre respectively. Select correct reaction:

(A) $t_1 = t_2$

(B) $t_1 = 2 \times t_2$

(C) ~~$t_1 > t_2$~~ $t_2 = 2 \times t_1$

(D) $t_2 > t_1$

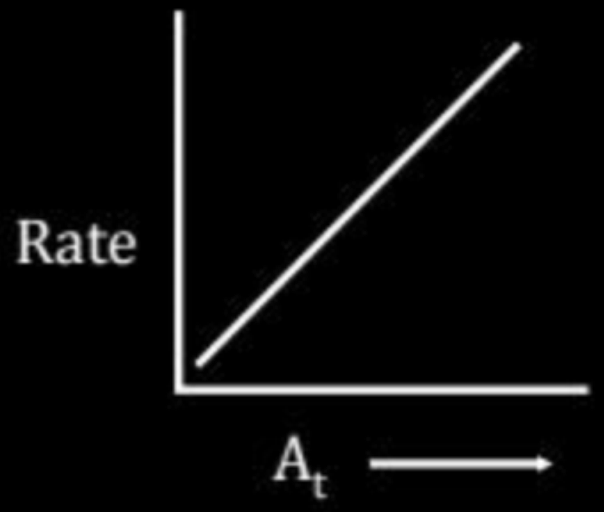
$A = 0.80 \rightarrow t_{\frac{1}{2}} = t_1 \Rightarrow t_1 = \frac{0.8}{2K}$ — (I)

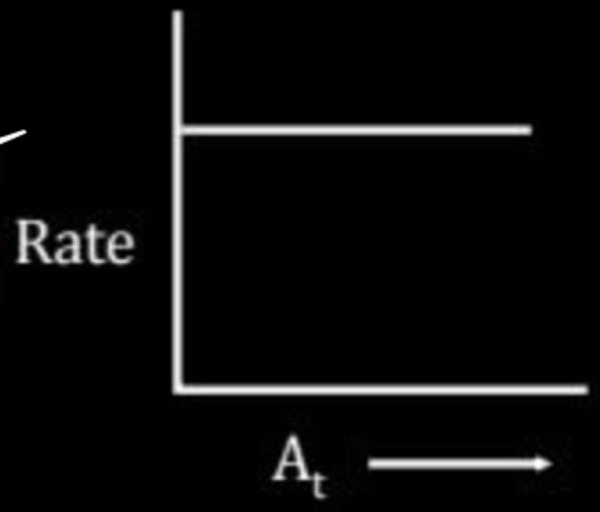
$A = 0.40 \rightarrow t_{\frac{1}{2}} = t_2 \Rightarrow t_2 = \frac{0.4}{2K}$ — (II)

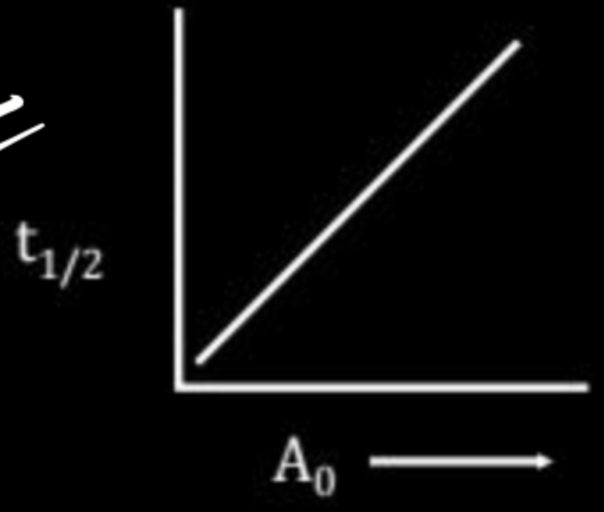
$\frac{t_1}{t_2} = \frac{0.8}{0.4} = 2$

$t_1 = 2 \times t_2 \Rightarrow t_1 > t_2$

Select the correct graphical representation for zero order reaction.

(A)


(B)


(C)


(D) B and C both correct

Q31. If the rate of a reaction is equal to the rate constant, the order of the reaction is

$R = K$

[CBSE AIPMT 2003]

(a) 2

(b) 3

(c) 0

(d) 1

Q34. $3A \rightarrow B + C$. It would be a zero order reaction, when

[CBSE AIPMT 2002]

(a) the rate of reaction is proportional to square of concentration A

(b) the rate of reaction remains same at any concentration of A

(c) the rate remains unchanged at any concentration of B and C

(d) the rate of reaction doubles if concentration of B is increased to double

Q42. The plot of concentration of the reactant versus time for a reaction is a straight line with a negative slope. This reaction follows

[CBSE AIPMT 1996]

(a) zero order rate equation (b) first order rate equation

(c) second order rate equation (d) third order rate equation

1^{st} Order Reaction $(n=1)$

$$A \longrightarrow B$$

A_0	0	$t=0$
$A_t = (A_0 - x)$	x	t Sec

$$R.O.R = K[A_t]^1$$

$$\boxed{R = K[A_t]^1}$$

$$R.O.R. = -\frac{dA/dt}{1} = +\frac{dB/dt}{1}$$

$$-\frac{dA}{dt} = K[A_t] \Rightarrow -\frac{dA}{[A_t]} = K\,dt$$

$$-\int_{A_0}^{A_t} \frac{dA}{[A_t]} = K\int_0^t dt$$

$$-\left[\ln A_t\right]_{A_0}^{A_t} = K\left[t\right]_0^t$$

$$-(\ln A_t - \ln A_0) = K(t-0)$$

$$\ln A_0 - \ln A_t = Kt$$

$$\ln \frac{A_0}{A_t} = Kt$$

$$K = \frac{1}{t} \ln \frac{A_0}{A_t} = \frac{2.3032}{t} \log \frac{A_0}{A_t}$$

$$R = K[A_t]$$

t_1 Sec $\rightarrow A_{t_1} \rightarrow R_1 = K[A_{t_1}]$

t_2 Sec $\rightarrow A_{t_2} \rightarrow R_2 = K[A_{t_2}]$.

$$\frac{R_1}{R_2} = \frac{[A_{t_1}]}{[A_{t_2}]}$$

$$K = \frac{2.3032}{t_2 - t_1} \log \frac{A_{t_1}}{A_{t_2}}$$

$$K = \frac{2.3032}{t_2 - t_1} \log \frac{R_1}{R_2}$$

CSD – 1st order reaction

① → $R = K[A_t]$

Rate of 1st order rxn depend upon Con. of Reactant (Rate ∝ Con.)

② → 100 % of 1st order rxn complete → at Infinite time

③ $A \longrightarrow B$

A_0	0	$t=0$	
$A_{t_1} = (A_0 - x_1)$	x_1	t_1 Sec	$K = \frac{1}{t_1}\ln\frac{A_0}{A_{t_1}}$
$A_{t_2} = (A_0 - x_2)$	x_2	t_2 Sec	$K = \frac{1}{t_2 - t_1}\ln\frac{A_{t_1}}{A_{t_2}}$

④ $t_1 \rightarrow A_{t_1} \rightarrow R_1 = K[A_{t_1}]$

$t_2 \rightarrow A_{t_2} \rightarrow R_2 = K[A_{t_2}]$

$$K = \frac{2.303}{t_2 - t_1}\log\frac{A_{t_1}}{A_{t_2}} = \frac{2.303}{t_2 - t_1}\log\frac{R_1}{R_2}$$

Q→ A → B . Initial and After 10 minute Con. of Reactant A is 0.8 and 0.4M respectively. If Rxn is 1st order than cal K=?

A_0 = 0.8, A_t = 0.4

$$K = \frac{2.3032}{10} \log \frac{0.8}{0.4}$$

$$= \frac{2.3032 \times \log 2}{10} = \frac{2.3032 \times 0.3010}{10}$$

$$= \frac{0.6932}{10} = 0.06932 \text{ minute}^{-1}$$

Q→ A → B . After 5 minutes & 10 minute Con. of Reactant A is 0.8 and 0.4M respectively. If Rxn is 1st order than cal K=?

t_1 = 5, t_2 = 10, A_{t_1} = 0.8, A_{t_2} = 0.4

$$K = \frac{2.3032}{t_2 - t_1} \log \frac{A_{t_1}}{A_{t_2}}$$

$$= \frac{2.3032}{10-5} \log \frac{0.8}{0.4} = \frac{2.3032}{5} \log 2$$

$$= \frac{0.6932}{5} \text{ minute}^{-1}$$

Q4. The rate of a first-order reaction is 0.04 mol L^{-1} s^{-1} at 10 sec and 0.03 mol L^{-1} s^{-1} at 20 sec after initiation of the reaction. The Rate Const of Rxn reaction is

[NEET 2016, Phase-I]

(a) 34.1 (b) 44.1

(c) 54.1 (d) NONE

$$\log\frac{4}{3} = \log 4 - \log 3$$

$$\log 2^2 - \log 3$$

$$2\log 2 - \log 3$$

$$2 \times 0.3 - 0.47$$

$$K = \frac{2.3032}{t_2 - t_1}\log\frac{R_1}{R_2}$$

$$= \frac{2.3032}{20-10}\log\frac{0.04}{0.03} = \frac{2.3032}{10}\log\frac{4}{3}$$


THANK YOU

MANTHAN NEET 2025

SANKALP NEET
VEDANTU

CHEMISTRY

chemical kinetics

Wrong Questn

⇒ Class test
+
⇒ NYTS-2.0
(Step-1st week)
or
NYTS-1.0



Lecture-05

Sarvesh Sir

Topic Name

1. SECONF ORDER REACTION
2. nth ORDER REACTION
3. activation energy

Qsd-1 –For a first order reaction, A → B, the reaction rate at reactant concentration of 0.01M is found to be 2.0×10^{-5} mol L^{-1} s^{-1}. The half-life period of the reaction is

(a) 220 s

(b) 30 s

(c) 300 s

(d) 347 s ✓

$$R = K[A_t]$$

$$2.0 \times 10^{-5} = K \times 0.01$$

$$K = 2 \times 10^{-3}$$

$$t_{\frac{1}{2}} = \frac{0.6932}{K} = \frac{0.6932}{2 \times 10^{-3}}$$

$$= \frac{693.2}{2}$$

$$t_{\frac{1}{2}} = 346.6 \text{ Sec}$$

Qsd-2 – If 60% of a first order reaction was completed in 60 min, 50% of the same reaction would be completed in approximately
(log 4 = 0.60, log 5 = 0.69)

(a) 50 min
(b) 45 min ✓
(c) 60 min
(d) 40 min

$$\frac{1}{60}\log\frac{100}{40} = \frac{1}{t}\log\frac{100}{50}$$

$$\frac{1}{60}\log\frac{10}{4} = \frac{1}{t}\log 2$$

$$\frac{1}{60}(\log 10 - \log 2^2) = \frac{1}{t}\times 0.3$$

$$\frac{1}{60}(1 - 0.3\times 2) = \frac{1}{t}\times 0.3$$

$$\frac{1}{60}\times 0.4 = \frac{1}{t}\times 0.3$$

$$t = \frac{60\times 0.3}{0.4}$$

t = 45 minutes

Qsd-3 – In a first order reaction, $A \rightarrow B$, if k is rate constant and initial concentration of the reactant A is 0.5 M, then the half-life is

x

$$t_{\frac{1}{2}} = \frac{\ln 2}{K} = \frac{2.303 \log 2}{K} = \frac{0.693}{K}$$

(a) $\frac{0.693}{0.5K}$

(b) $\frac{\log 2}{K}$

(c) $\frac{\log 2}{K\sqrt{0.5}}$

(d) ✓ $\frac{\ln 2}{K}$

$\frac{?}{3}$

1^{st} order Rxn in term pressure

* minimum ek gaseous Reactant or product ho

$$PV = nRT$$

$$P = \frac{n}{V} RT$$

$$P = [Con]\, RT$$

(R: Const, T: Const)

$$\boxed{P \propto [Con]}$$

Jis taraha se Mole or Con ko +ve or -ve krte, wase pressure ko +ve or -ve kr sakte ho.

	$A(g)$	$\longrightarrow$	$2B(g)$	$+\ C(g)$	
	P_0		0	0	$t=0$
$P_t =$	$(P_0 - P_1)$		$2P_1$	P_1	t Sec

$$K = \frac{2.3032}{t} \log \frac{A_0}{A_t}$$

$$K = \frac{2.3032}{t} \log \frac{P_0}{P_t}$$

P_0 → initial pressure of Reactant

P_t → After 't' Sec, pressure of Reactant

Q → $A \longrightarrow 2B$

Initial pressure of Container is 200 mm of Hg (P_0) and After 10 Sec the pressure of Reactant is 100 mm of Hg (P_t). Calculate K of Rxn.

a) 4.4606

b) 0.446

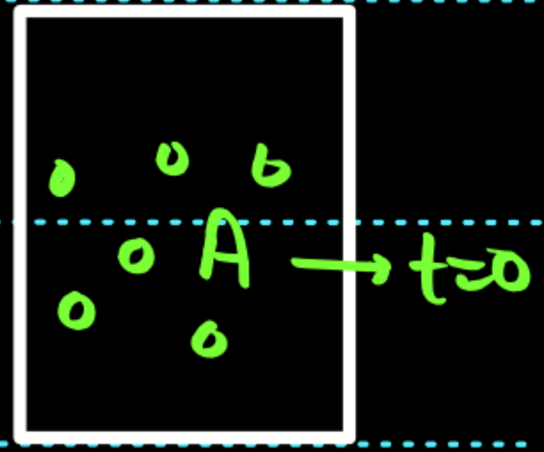
c) 0.203

~~d)~~ NONE

$$K = \frac{2.3032}{t} \log \frac{P_0}{P_t}$$

$$= \frac{2.3032}{10} \log \frac{200}{100}$$

$$= \frac{2.3032 \times \log 2}{10} = \frac{0.6932}{10} = 0.06932$$



Q→ $A \longrightarrow 2B$

initial pressure of Container is 200mm of Hg ($\to P_0$) and After 10 Sec the pressure of Container is 300mm of Hg. Calculate K of Rxn.

a) 4.4606

b) 0.446

c) 0.203

d) NONE

	A	$\longrightarrow$	$2B$	
	200		0	$t=0$
$P_t =$	$200-P$		$2P$	10sec

$$P_T = P_A + P_B$$

$$300 = 200 - P + 2P \Rightarrow \boxed{100 = P}$$

$$K = \frac{2.3032}{t}\log\frac{P_0}{P_t}$$

$$\frac{2.3032}{10}\log\frac{200}{200-P}$$

$$\frac{2.3032}{10}\log\frac{200}{100}$$

$$= 0.06932$$

Q → $A \rightarrow 2B$

After 10 Sec pressure of Reactant is 100 mm of Hg (P_t) and very long time (After Complete rxn) the pressure of Container is 400 mm of Hg. Calculate Value of K

a) 2.3032

b) 0.6932

c) 0.06932 ✓

d) NONE

$$K = \frac{2.3032}{t} \log \frac{P_0}{P_t}$$

	$A \rightarrow$	$2B$	
	P_0	0	$t=0$
	0	$2P_0$	Complete rxn

$$P_T = P_B \Rightarrow 400 = 2P_0 \Rightarrow P_0 = 200$$

$$K = \frac{2.3032}{10} \log \frac{P_0}{100}$$

$$K = \frac{2.3032}{10} \log \frac{200}{100}$$

$$= 0.06932$$

Pseudo 1st order Reaction

order of rxn is 1 but molecularity of rxn is greater than one. this type of 1st order rxn is called pseudo 1st order rxn.

Ex $A \rightarrow B \rightarrow X$

$\downarrow$

$M=1 \rightarrow X$

Ex → $A + B \rightarrow C$ (element)

$M=2$,

13:3

Ex → $CH_3COO|C_2H_5 + H_2O \xrightleftharpoons{H^+} CH_3COOH + C_2H_5OH$ (H | OH)

$CH_3COOC_2H_5 + H_2O + H^+ \rightleftharpoons CH_3COOH + C_2H_5OH$

$R.O.R. = K[ester][H_2O]^0[H^+]^0 = R.O.R. = [Ester]^1$

Ex → $CH_3-CH_2-Br + H_2O \xrightarrow[\text{Excess}]{SN^2} CH_3-CH_2-OH + HBr$

SN^2 ⇒ bimolecular Nucleophilic Substitution Rxn

(M=2) $R.O.R = K[C_2H_5-Br][H_2O]^0 \Rightarrow R.O.R = K[C_2H_5Br]^1$

Ex → $CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + CH_3COOH$

excess ↓ O

Select Correct option

a) $R = K[\text{Ester}]$ ✓

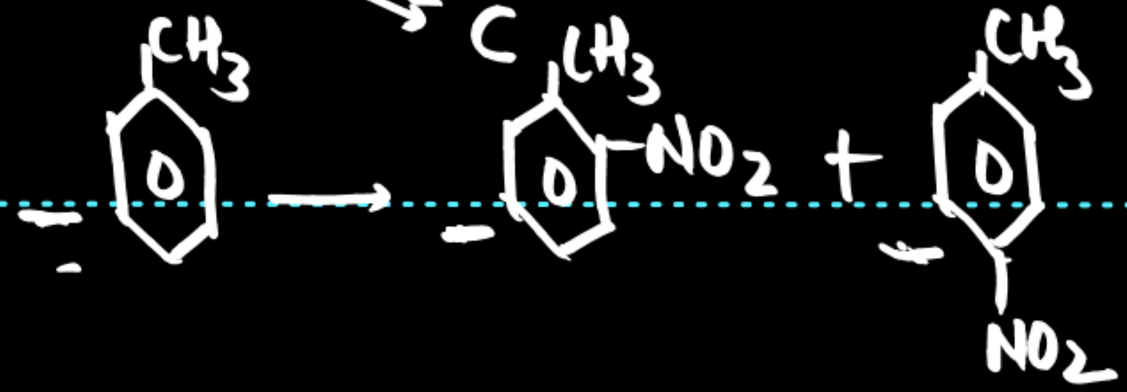
b) $R = K[\text{ester}][H_2O]$ ✗

c) $R = K[\text{ester}][NaOH]$ ✗

d) NONE

parallel 1st order rxn
Successive 1st order rxn } out off syllabus

$A \xrightarrow{K_1} B$, $A \xrightarrow{K_2} C$



CSD → 1st order rxn in term of pressure.

$$K = \frac{2.3032}{t} \log \frac{P_0}{P_t}$$

P_0 → initial pressure of Reactant

P_t → After 't' sec pressure of Reactant

Pseudo 1st order

→ Solvent (H_2O) = w.r.t Solvent → order = zero

→ Excess Reagent (Reactant) → w.r.t = zero order

→ Catalyst = w.r.t = zero order

Second order of reaction

$$K = \frac{1}{t}\left[\frac{1}{A_t} - \frac{1}{A_0}\right]$$

$$t_{\frac{1}{2}} = \frac{1}{KA_0}$$

n^{th} order → $t_{\frac{1}{2}} \propto (A_0)^{1-n}$

n^{th} order of Reaction

$$A \longrightarrow B$$

$$R.O.R = K[A_t]^n \quad n \rightarrow \text{order of rxn}$$

$$K = \frac{1}{(n-1)t}\left[\frac{1}{(A_t)^{n-1}} - \frac{1}{(A_0)^{n-1}}\right]$$

$$t_{\frac{1}{2}} = \frac{1}{(n-1)k} \times \frac{2^{n-1}-1}{(A_0)^{n-1}}$$

$n = 2 \rightarrow$ Second order of rxn

$$K = \frac{1}{t}\left[\frac{1}{A_t} - \frac{1}{A_0}\right]$$

↓

2^{nd} order of rxn

$$t_{\frac{1}{2}} = \frac{1}{KA_0}$$

$$t_{\frac{1}{2}} \propto \frac{1}{(A_0)^{n-1}}$$

$$t_{\frac{1}{2}} \propto (A_0)^{1-n}$$

$$n = 0 \rightarrow t_{\frac{1}{2}} \propto A_0 \rightarrow t_{\frac{1}{2}} = \frac{A_0}{2K}$$

$$n = 1 \rightarrow t_{\frac{1}{2}} \propto \text{Constant} \rightarrow t_{\frac{1}{2}} = \frac{0.6932}{K}$$

$$n = 2 \rightarrow t_{\frac{1}{2}} \propto \frac{1}{(A_0)} \rightarrow t_{\frac{1}{2}} = \frac{1}{KA_0}$$

Q → A ⟶ B

$t_{\frac{1}{2}}$ of above rxn at initial Con of A (2M) is 10 sec. If the initial Con of A taken 4M than $t_{\frac{1}{2}}$ is 15 sec. Select correct order of rxn

a) zero ✓

b) 1^{st}

c) 2^{nd}

d) NONE

Q → $A \longrightarrow B$

$t_{\frac{1}{2}}$ of above rxn at initial Con of A (2M) is 10Sec. If the initial Con of A taken 4M than $t_{\frac{1}{2}}$ is 5 Sec. Select correct order of rxn

a) zero

b) 1st

c) 2nd

d) NONE

$t_{\frac{1}{2}} \propto (A_0)^{1-n}$

13:3

Q → $A \longrightarrow B$

$t_{\frac{1}{2}}$ of above rxn at initial Con of A (2M) is 10Sec. If the initial Con of A taken 4M than $t_{\frac{1}{2}}$ is 10 Sec. Select correct order of rxn

a) zero

b) 1st ✓

c) 2nd

d) NONE

Q → $A \rightarrow B$

$t_{\frac{1}{2}} = K\sqrt{\frac{3}{C_0}}$, where C_0 is initial Con. of Reactant

Calculate order of rxn

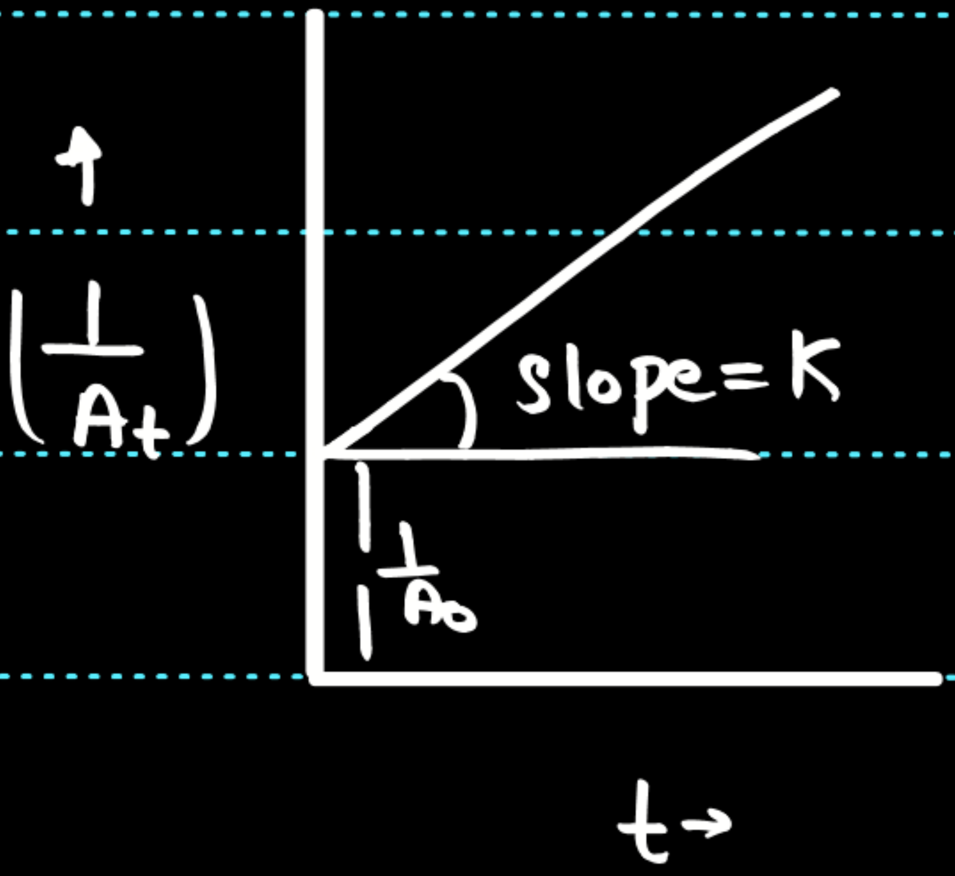
a) $\frac{1}{2}$ b) $-\frac{1}{2}$ c) zero ~~d)~~ NONE

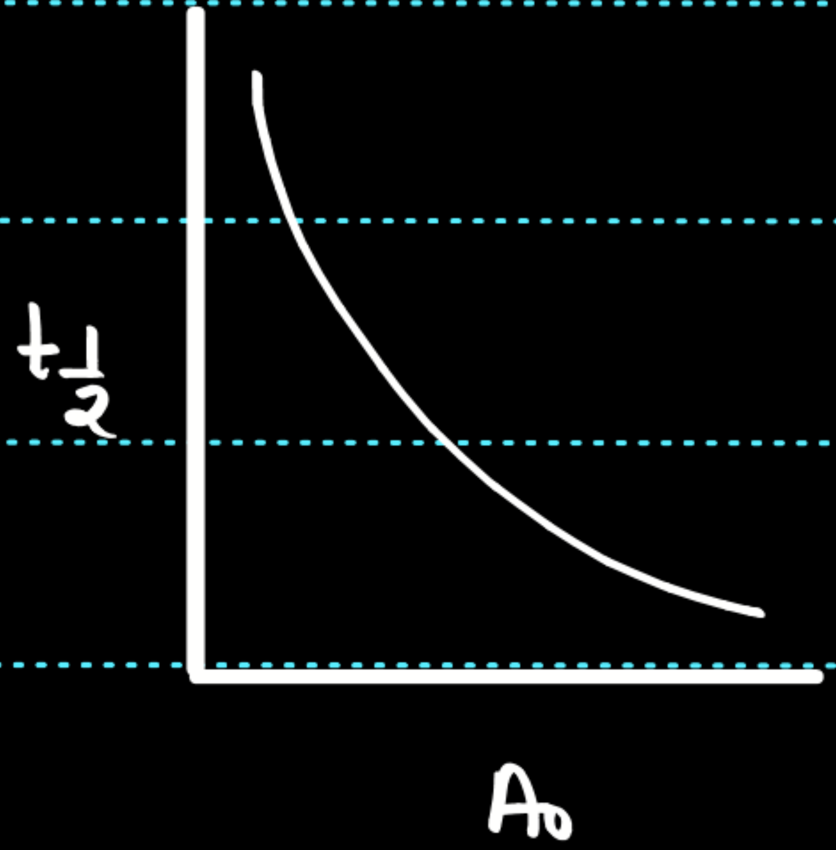
$t_{\frac{1}{2}} \propto \frac{1}{\sqrt{C_0}} \Rightarrow t_{\frac{1}{2}} \propto (C_0)^{-\frac{1}{2}}$ | $= -\frac{1}{2} = 1-n$

$t_{\frac{1}{2}} \propto (A_0)^{1-n}$ | $n = 1 + \frac{1}{2} = 3/2$

graph of 2^{nd} order

$$t_{\frac{1}{2}} = \frac{1}{K A_0}$$





$$t_{\frac{1}{2}} \times A_0 = \frac{1}{K}$$

$$P \times V = K$$

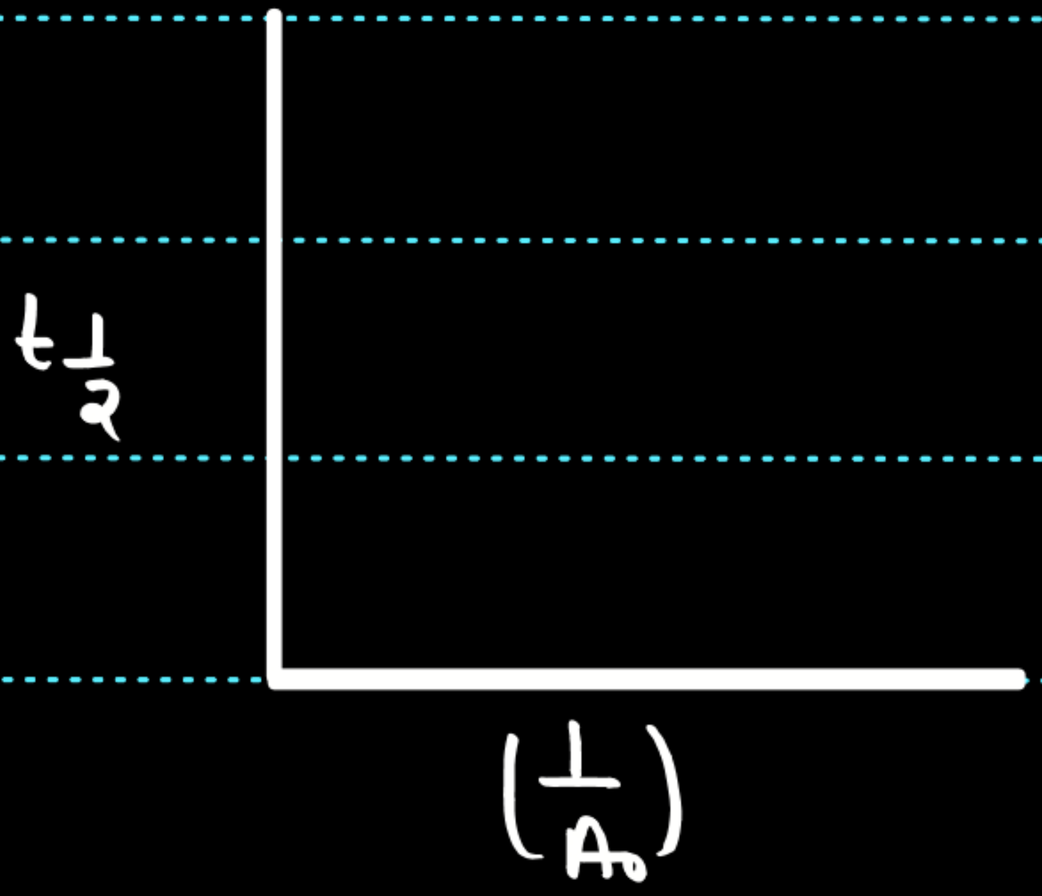
Boyle's law

Rectangular Hyperbola

$$K = \frac{1}{t}\left[\frac{1}{A_t} - \frac{1}{A_0}\right]$$

$$Kt = \frac{1}{A_t} - \frac{1}{A_0} \Rightarrow \underset{y}{\frac{1}{A_t}} = \underset{m\bar{x}}{Kt} + \underset{c}{\frac{1}{A_0}}$$

H.W.




THANK
YOU

MANTHAN NEET 2025

CHEMISTRY

chemical kinetics

Wrong Questⁿ

⇒ Class test
+
⇒ NYTS-2.0
(Step-1st week)
or
NYTS-1.0

Lecture-05



Sarvesh Sir

Topic Name

1. SECONF ORDER REACTION
2. nth ORDER REACTION
3. activation energy

Qsd-1 –For a first order reaction, A → B, the reaction rate at reactant concentration of 0.01M is found to be 2.0×10^{-5} mol L^{-1} s^{-1}. The half-life period of the reaction is

A_t R

(a) 220 s
(b) 30 s
(c) 300 s
(d) 347 s ✓

$$R = K[A_t]$$

$$2.0 \times 10^{-5} = K \times 0.01$$

$$K = \underline{2 \times 10^{-3}}$$

$$t_{\frac{1}{2}} = \frac{0.6932}{K} = \frac{0.6932}{2 \times 10^{-3}}$$

$$= \frac{693.2}{2}$$

$$t_{\frac{1}{2}} = \underline{346.6} \text{ Sec}$$

Qsd-2 – If 60% of a first order reaction was completed in 60 min, 50% of the same reaction would be completed in approximately

(log 4 = 0.60, log 5 = 0.69)

(a) 50 min

(b) 45 min ✓

(c) 60 min

(d) 40 min

$$\frac{1}{60}\log\frac{100}{40} = \frac{1}{t}\log\frac{100}{50}$$

$$\frac{1}{60}\log\frac{10}{4} = \frac{1}{t}\log 2$$

$$\frac{1}{60}(\log 10 - \log 2^2) = \frac{1}{t}\times 0.3$$

$$\frac{1}{60}(1 - 0.3\times 2) = \frac{1}{t}\times 0.3$$

$$\frac{1}{60}\times 0.4 = \frac{1}{t}\times 0.3$$

$$t = \frac{60\times 0.3}{0.4} = 15\times 3$$

t = 45 minutes

Qsd-3 – In a first order reaction, A → B, if k is rate constant and initial concentration of the reactant A is 0.5 M, then the half-life is

(a) $\frac{0.693}{0.5K}$

(b) $\frac{\log 2}{K}$

(c) $\frac{\log 2}{K\sqrt{0.5}}$

(d) $\frac{\ln 2}{K}$ ✓

$t_{\frac{1}{2}} = \frac{\ln 2}{K} = \frac{2.303}{K}\log 2 = \frac{0.693}{K}$

$\frac{?}{3}$

1^{st} order Rxn in term pressure

* minimum ek gaseous Reactant or product ho

$$PV = nRT$$

$$P = \frac{n}{V} RT$$

$$P = [Con] RT$$

(R: Const, T: Const)

$$\boxed{P \propto [Con]}$$

Jis taraha se mole or Con ko +ve or -ve krte, wase pressure ko +ve or -ve kr sakte ho.

	$A_{(g)}$	$\longrightarrow$	$2B_{(g)}$	$+$	$C_{(g)}$	
	P_0		0		0	t=0
$P_t =$	$(P_0 - P_1)$		$2P_1$		P_1	t Sec

$$K = \frac{2.3032}{t} \log \frac{A_0}{A_t}$$

$$K = \frac{2.3032}{t} \log \frac{P_0}{P_t}$$

P_0 → initial pressure of Reactant

P_t → After 't' Sec, pressure of Reactant

Q→ $A \longrightarrow 2B$

initial pressure of Container is 200 mm of Hg (P_0) and After 10 Sec the pressure of Reactant is 100 mm of Hg (P_t). Calculate K of Rxn.

a) 4.4606

b) 0.446

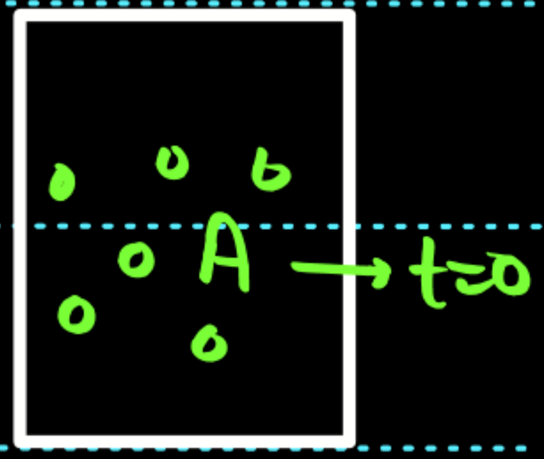
c) 0.203

~~d) NONE~~

$$K = \frac{2.3032}{t} \log \frac{P_0}{P_t}$$

$$= \frac{2.3032}{10} \log \frac{200}{100}$$

$$= \frac{2.3032 \times \log 2}{10} = \frac{0.6932}{10} = 0.06932$$



Q → $A \longrightarrow 2B$

initial pressure of Container is 200 mm of Hg ($\rightarrow P_0$) and After 10 Sec the pressure of Container is 300 mm of Hg. Calculate K of Rxn.

a) 4.4606

b) 0.446

c) 0.203

d) NONE

A	$\longrightarrow$	$2B$	
200		0	t=0
$P_t = 200-P$		$2P$	10 sec

$P_T = P_A + P_B$

$300 = 200 - P + 2P \Rightarrow 100 = P$

$$K = \frac{2.3032}{t}\log\frac{P_0}{P_t}$$

$$\frac{2.3032}{10}\log\frac{200}{200-P}$$

$$\frac{2.3032}{10}\log\frac{200}{100}$$

$$= 0.06932$$

Q → $A \rightarrow 2B$

After 10 Sec pressure of Reactant is 100 mm of Hg (P_t) and very long time (After Complete rxn) the pressure of Container is 400 mm of Hg. Calculate Value of K

a) 2.3032

b) 0.6932

c) 0.06932 ✓

d) NONE

$$K = \frac{2.3032}{t} \log \frac{P_0}{P_t}$$

A	$\rightarrow$	$2B$	
P_0		0	$t=0$
0		$2P_0$	Complete rxn

$$P_T = P_B \Rightarrow 400 = 2P_0 \Rightarrow P_0 = 200$$

$$K = \frac{2.3032}{10} \log \frac{P_0}{100}$$

$$K = \frac{2.3032}{10} \log \frac{200}{100}$$

$$= 0.06932$$

Pseudo 1st order Reaction

order of rxn is 1 but molecularity of rxn is greater than one. this type of 1st order rxn is called pseudo 1st order rxn.

Ex $A \longrightarrow B \rightarrow X$

$\downarrow$

$M=1 \rightarrow X$

Ex → $A + B \longrightarrow C$ (element)

$M=2$,

Ex → $CH_3COO|C_2H_5 + H_2O \xrightleftharpoons{H^+} CH_3COOH + C_2H_5OH$ (H | OH)

$CH_3COOC_2H_5 + H_2O + H^+ \rightleftharpoons CH_3COOH + C_2H_5OH$

$R.O.R. = K[ester][H_2O]^0[H^+]^0 = R.O.R. = [Ester]^1$

Ex → $CH_3-CH_2-Br + H_2O \xrightarrow[Excess]{SN^2} CH_3-CH_2-OH + HBr$

SN^2 ⇒ bimolecular Nucleophilic Substitution Rxn

(M=2) $R.O.R = K[C_2H_5-Br][H_2O]^0 \Rightarrow R.O.R = K[C_2H_5Br]^1$

Ex → $CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + CH_3COOH$

excess ↓ 0

Select Correct option

a) $R = K[Ester]$ ✓

b) $R = K[ester][H_2O]$ ✗

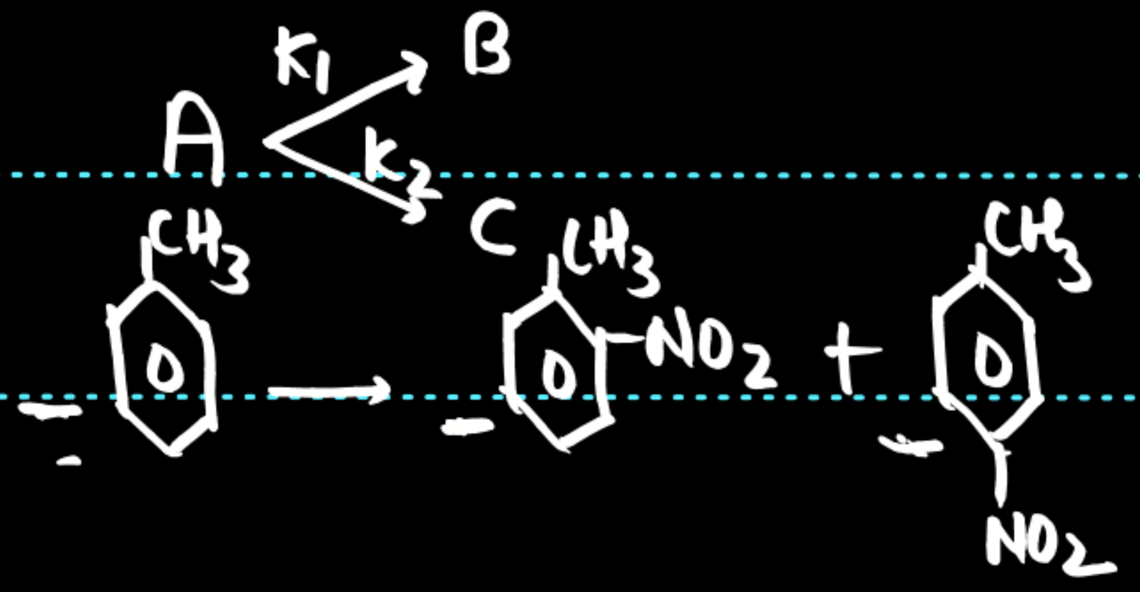
c) $R = K[ester][NaOH]$ ✗

d) NONE

parallel 1st order rxn

Successive 1st order rxn

} out off syllabus



CSD → 1^{st} order rxn in term of pressure.

$$K = \frac{2.3032}{t} \log \frac{P_0}{P_t}$$

P_0 → initial pressure of Reactant

P_t → After 't' sec pressure of Reactant

Pseudo 1^{st} order

→ Solvent (H_2O) = w.r.t Solvent → order = zero

→ Excess Reagent (Reactant) → w.r.t = zero order

→ Catalyst = w.r.t = zero order

Second order of reaction

$$K = \frac{1}{t}\left[\frac{1}{A_t} - \frac{1}{A_0}\right]$$

$$t_{\frac{1}{2}} = \frac{1}{KA_0}$$

n^{th} order → $t_{\frac{1}{2}} \propto (A_0)^{1-n}$

n^{th} order of Reaction

$A \longrightarrow B$

$R\cdot O\cdot R = K[A_t]^n$ $n \rightarrow$ order of rxn

$$K = \frac{1}{(n-1)t}\left[\frac{1}{(A_t)^{n-1}} - \frac{1}{(A_0)^{n-1}}\right]$$

$$t_{\frac{1}{2}} = \frac{1}{(n-1)k} \times \frac{2^{n-1}-1}{(A_0)^{n-1}}$$

$n = 2 \rightarrow$ Second order of rxn

$$K = \frac{1}{t}\left[\frac{1}{A_t} - \frac{1}{A_0}\right]$$

$\downarrow$

2^{nd} order of rxn

$$t_{\frac{1}{2}} = \frac{1}{kA_0}$$

$$t_{\frac{1}{2}} \propto \frac{1}{(A_0)^{n-1}}$$

$$t_{\frac{1}{2}} \propto (A_0)^{1-n}$$

$$n = 0 \rightarrow t_{\frac{1}{2}} \propto A_0 \rightarrow t_{\frac{1}{2}} = \frac{A_0}{2K}$$

$$n = 1 \rightarrow t_{\frac{1}{2}} \propto \text{Constant} \rightarrow t_{\frac{1}{2}} = \frac{0.6932}{K}$$

$$n = 2 \rightarrow t_{\frac{1}{2}} \propto \frac{1}{(A_0)} \rightarrow t_{\frac{1}{2}} = \frac{1}{KA_0}$$

Q → $A \longrightarrow B$

$t_{\frac{1}{2}}$ of above rxn at initial Con of A (2M) is 10 Sec. If the initial Con of A taken 4M than $t_{\frac{1}{2}}$ is 15 Sec. Select correct order of rxn

a) zero
b) 1^{st}
c) 2^{nd}
d) NONE

Q → $A \longrightarrow B$

$t_{\frac{1}{2}}$ of above rxn at initial Con of A (2M) is 10 Sec. If the initial Con of A taken 4M than $t_{\frac{1}{2}}$ is 5 Sec. Select correct order of rxn

a) zero

b) 1st

c) 2nd

d) NONE

$t_{\frac{1}{2}} \propto (A_0)^{1-n}$

Q → $A \longrightarrow B$

$t_{\frac{1}{2}}$ of above rxn at initial Con of A (2M) is 10 Sec. If the initial Con of A taken 4M than $t_{\frac{1}{2}}$ is 10 Sec. Select correct order of rxn

a) zero

b) 1st

c) 2nd

d) NONE

Q → $A \rightarrow B$

$t_{\frac{1}{2}} = K\sqrt{\frac{3}{C_0}}$, where C_0 is initial Con. of Reactant

Calculate order of rxn

a) $\frac{1}{2}$ b) $-\frac{1}{2}$ c) zero ~~d)~~ NONE

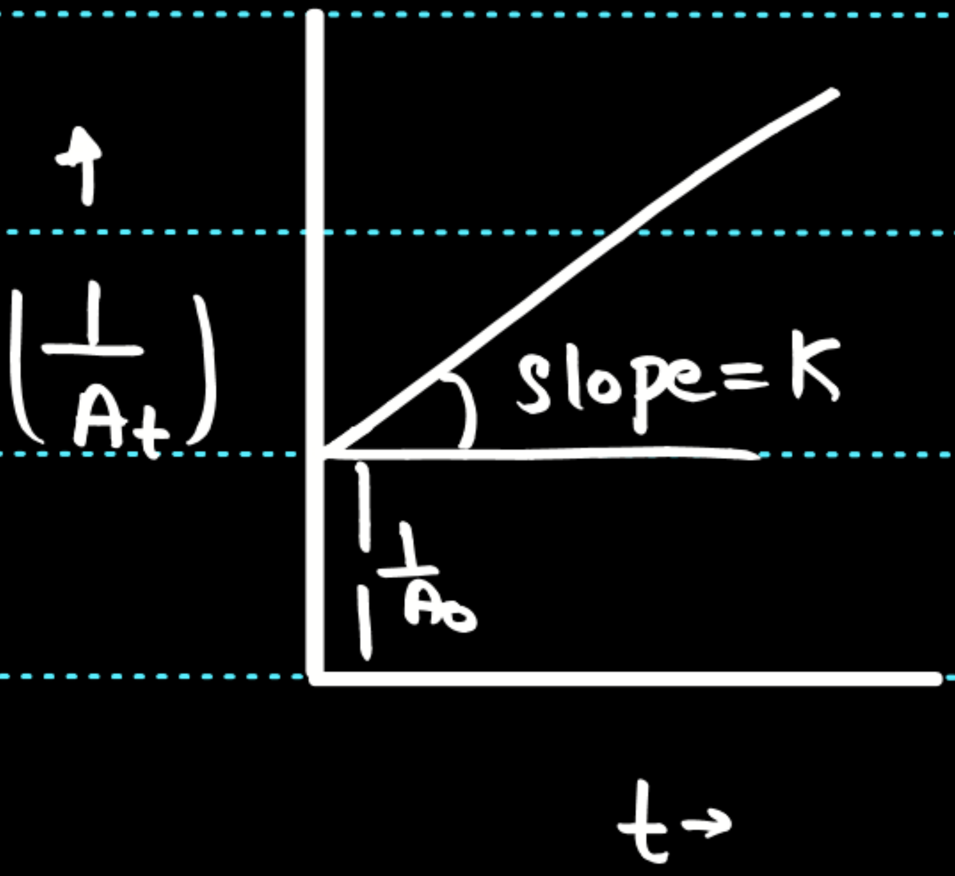
$t_{\frac{1}{2}} \propto \frac{1}{\sqrt{C_0}} \Rightarrow t_{\frac{1}{2}} \propto (C_0)^{-\frac{1}{2}}$

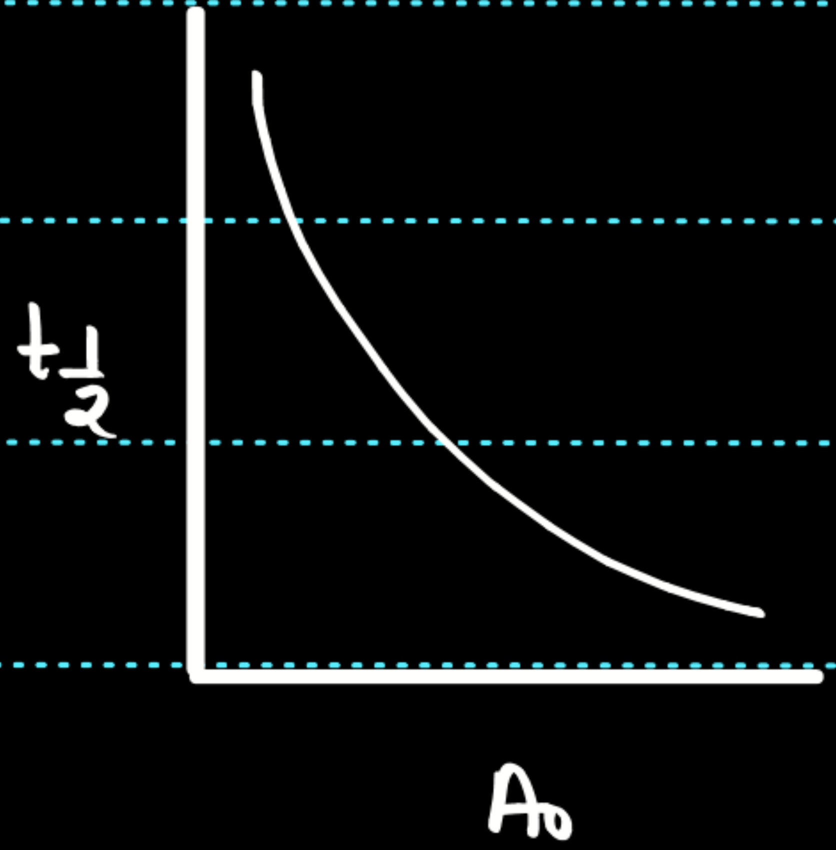
$t_{\frac{1}{2}} \propto (A_0)^{1-n}$

$= -\frac{1}{2} = 1-n$

$n = 1+\frac{1}{2} = 3/2$

graph of 2^{nd} order





$$t_{\frac{1}{2}} = \frac{1}{KA_0}$$

$$t_{\frac{1}{2}} \times A_0 = \frac{1}{K}$$

$$P \times V = K$$

Boyle's law

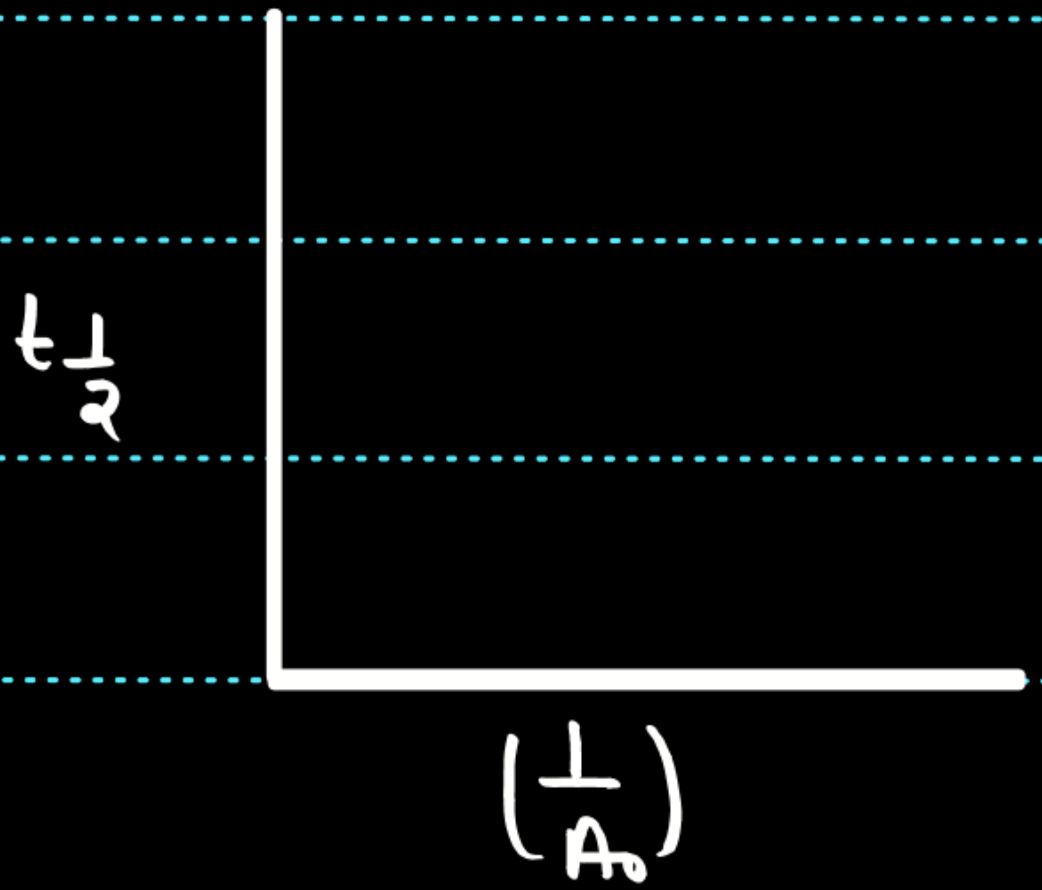
Rectangular Hyperbola

$$K = \frac{1}{t}\left[\frac{1}{A_t} - \frac{1}{A_0}\right]$$

$$Kt = \frac{1}{A_t} - \frac{1}{A_0} \Rightarrow \frac{1}{A_t} = Kt + \frac{1}{A_0}$$

$y = m\bar{x} + c$

H.W.




THANK
YOU

MANTHAN NEET 2025

CHEMISTRY

chemical kinetics

Lecture-06



Sarvesh Sir

Qsd-1. 50% of a first order reaction, was completed in 12 minute. When will 99.9% of the reaction complete?

(a) 50 minute
(b) 46 minute
(c) 49 minute
(d) 120 minute

$\rightarrow t_{99.9\%} = 10 \times t_{\frac{1}{2}}$

$= 10 \times 12$

$= 120$ minute

$\frac{1}{12} \log \frac{100}{50} = \frac{1}{t} \log \frac{100}{0.1}$

$\frac{1}{12} \log 2 = \frac{1}{t} \log 1000 = \frac{1}{t} \log 10^3$

$\frac{1}{120} \times 0.3 = \frac{1}{t} \times 3$

$t = 120$ minutes

Qsd-2. The half-life period of a substance is 50 minutes at a certain initial concentration. When concentration is reduced to one-half, half-life is found to 25 minutes. Order of reaction is

✓(a) Zero
(b) First
(c) Second
(d) Third

M-1 → $t_{\frac{1}{2}} \propto (A_0)^{1-n}$

→ $n=0$

$t_{\frac{1}{2}} \propto A_0$

$\frac{?}{2}$

M-2 $t_{\frac{1}{2}} \propto (A_0)^{1-n}$

$50 \propto \left(\frac{A_0}{1}\right)^{1-n}$

$25 \propto \left(\frac{A_0}{2}\right)^{1-n}$

$\frac{50}{25} = 2^{1-n}$

$2^1 = 2^{1-n}$

$1 = 1-n$

$n = 1-1 = 0$

$\boxed{n=0}$

Effect of temperature in Rate of Reaction

Arrhinus Equation → Relation b/w temp. and Rate Constant

$$K = A e^{-\frac{E_a}{RT}}$$

where → K = Rate Constant

→ E_a = Activation Energy

R = Gas Const

T = temp.

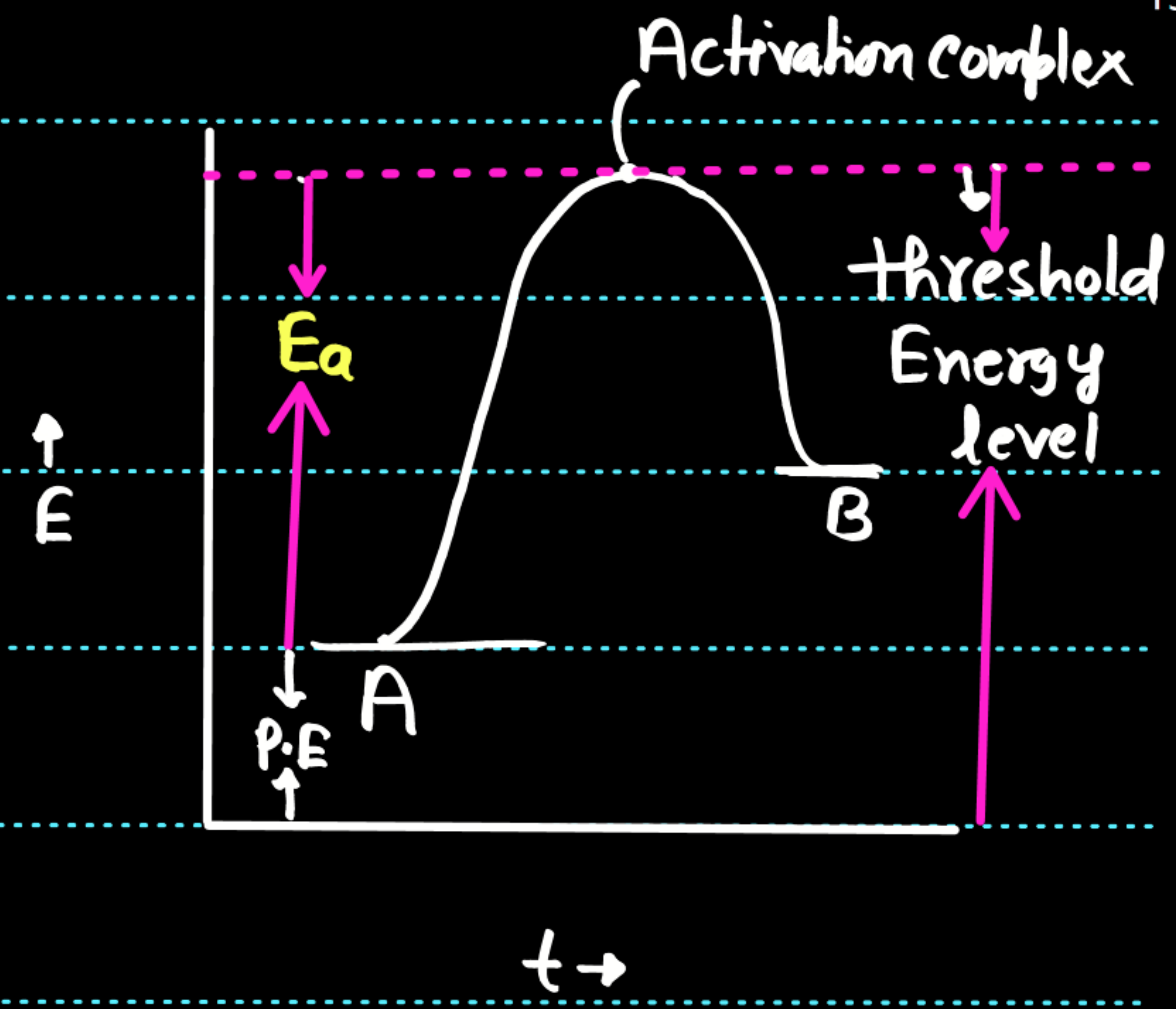
→ A = Arrhinus parameter or Arrhinus frequency collision factor

Activation Energy

→ Rxn Occurs due to collision

→ during rxn, Energy of Reactant and product change

Ex→ $A \longrightarrow B$



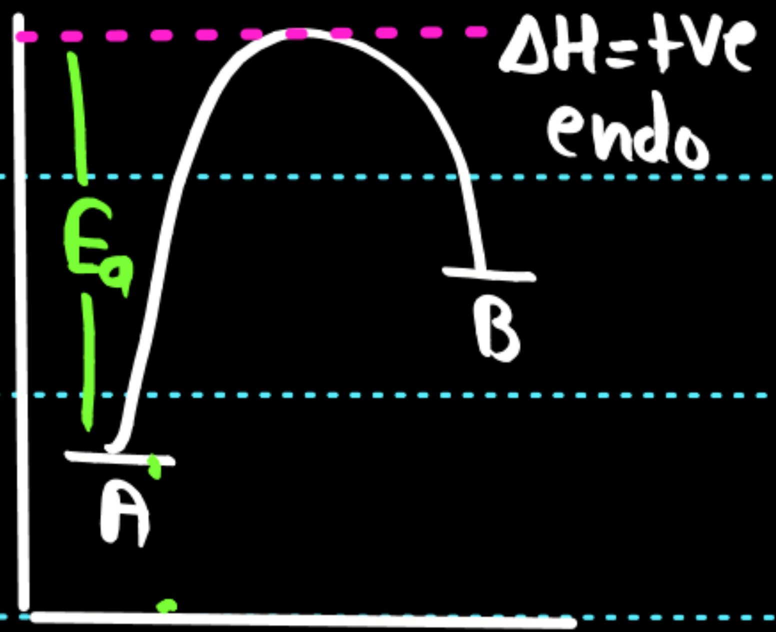
Threshold E = Activation E (E_a) + P.E.

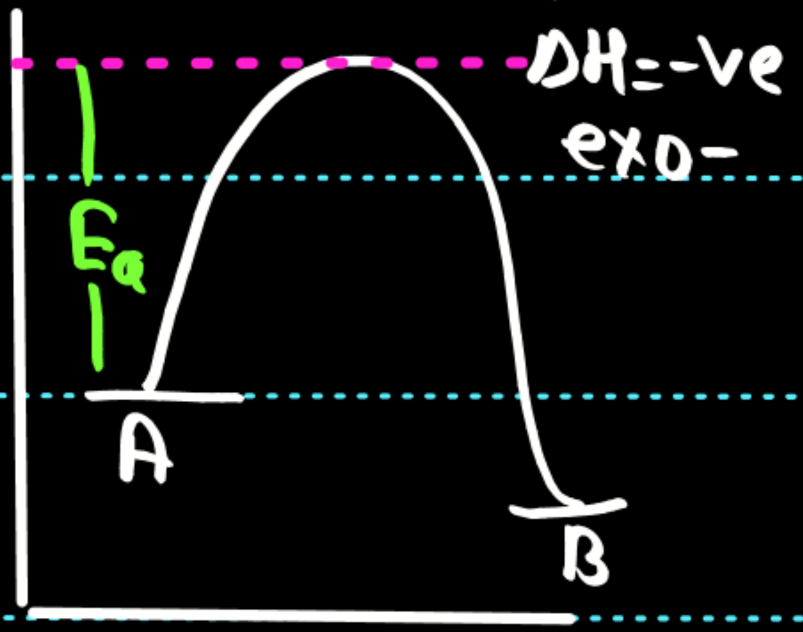
total Energy required of Reactant molecule to reach Activation Complex

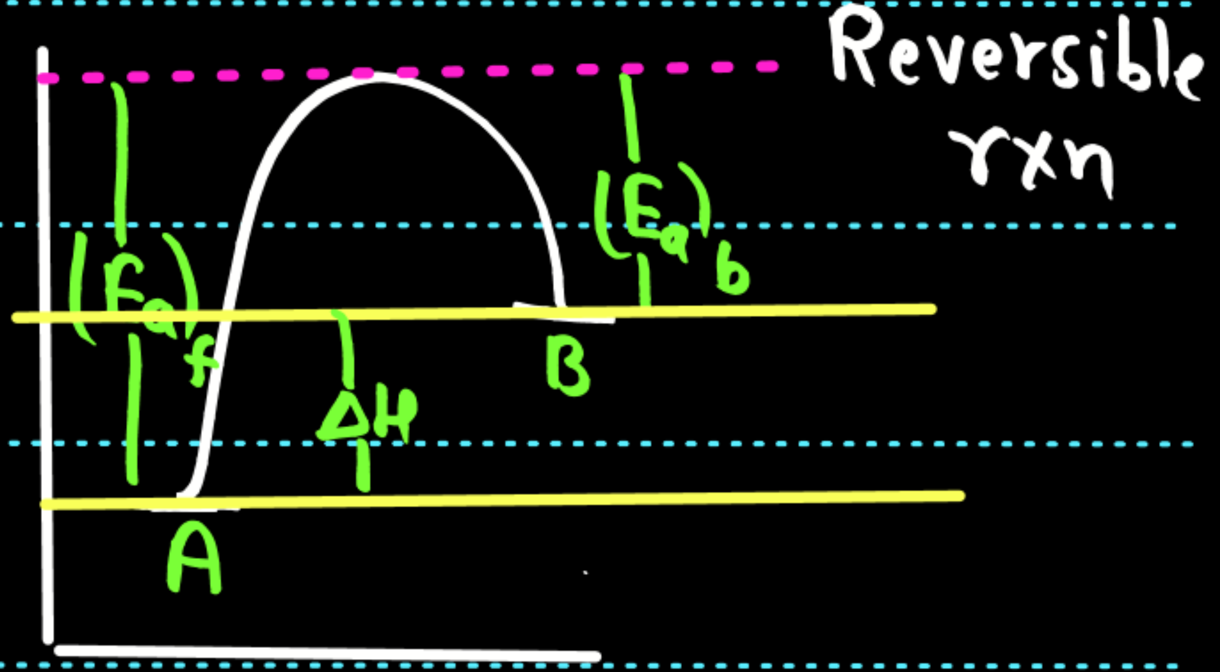
→ Ea Can not be zero → $E_a \neq 0$ → NEET-2023

→ $E_a \neq$ negative bhi nahi hoti

*** → Ea depend upon temperature theoretically, but very very low change occurs in Ea, large change of temp. (Note → Questⁿ aur proof Krte time hum Const suppose Kr Ke chalte hai)







$$\Delta H = (E_a)_f - (E_a)_b$$

Endothermic → $\Delta H = +ve$ → $(E_a)_f > (E_a)_b$

Exothermic → $\Delta H = -ve$ → $(E_a)_f < (E_a)_b$

ΔH = Heat of Reaction or Enthalpy of Reaction

Arrhinus parameter (A) → It is a Const., Value of A depend upon temp.

theoretically, very very less change in large change of temp

$$K = A e^{-\frac{E_a}{RT}}$$

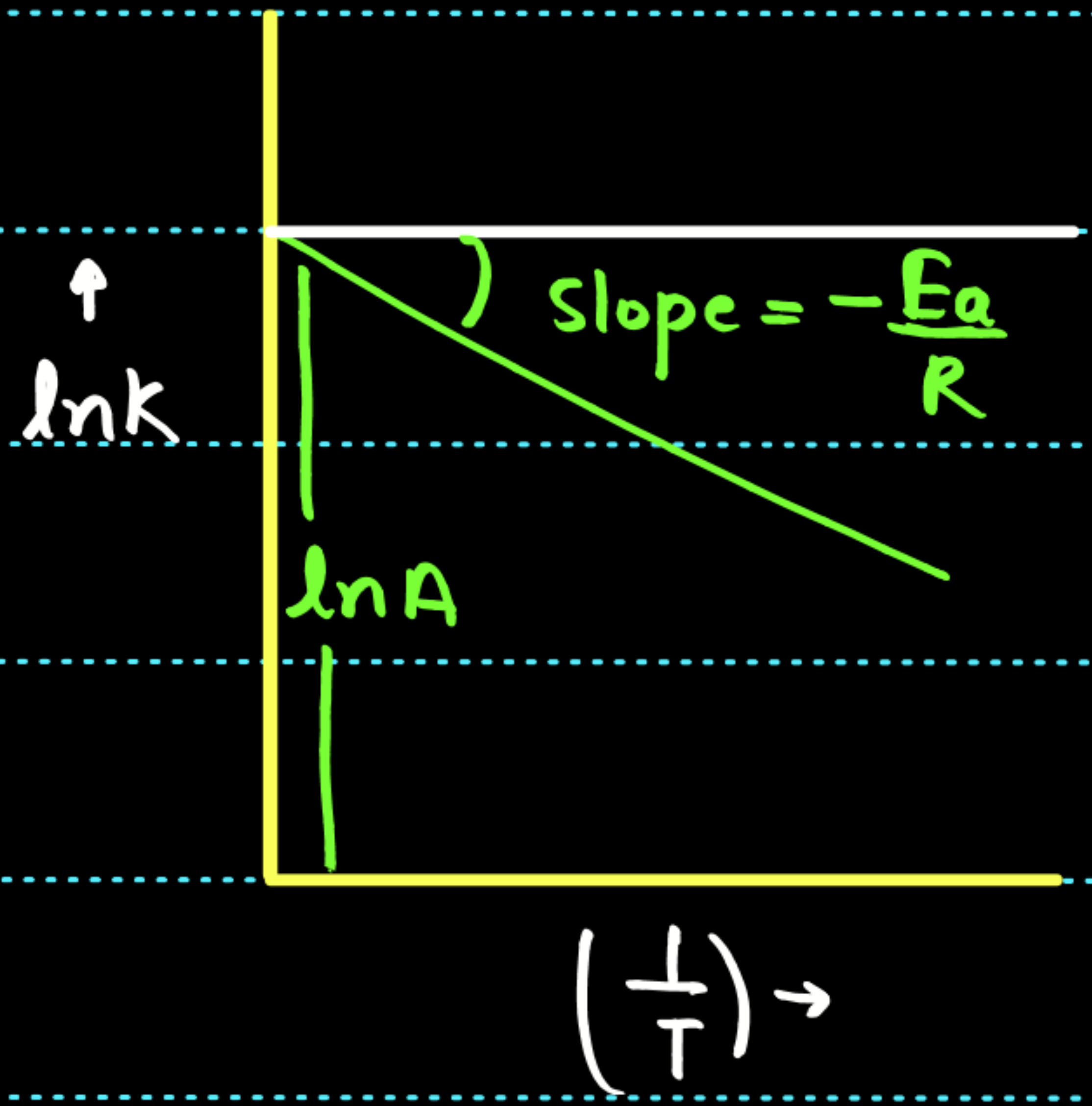
$$\ln K = \ln A + \ln e^{-E_a/RT}$$

$$\ln K = \ln A - \frac{E_a}{RT} \ln_e e$$

***

$$\ln K = -\frac{E_a}{R}\left(\frac{1}{T}\right) + \ln A$$

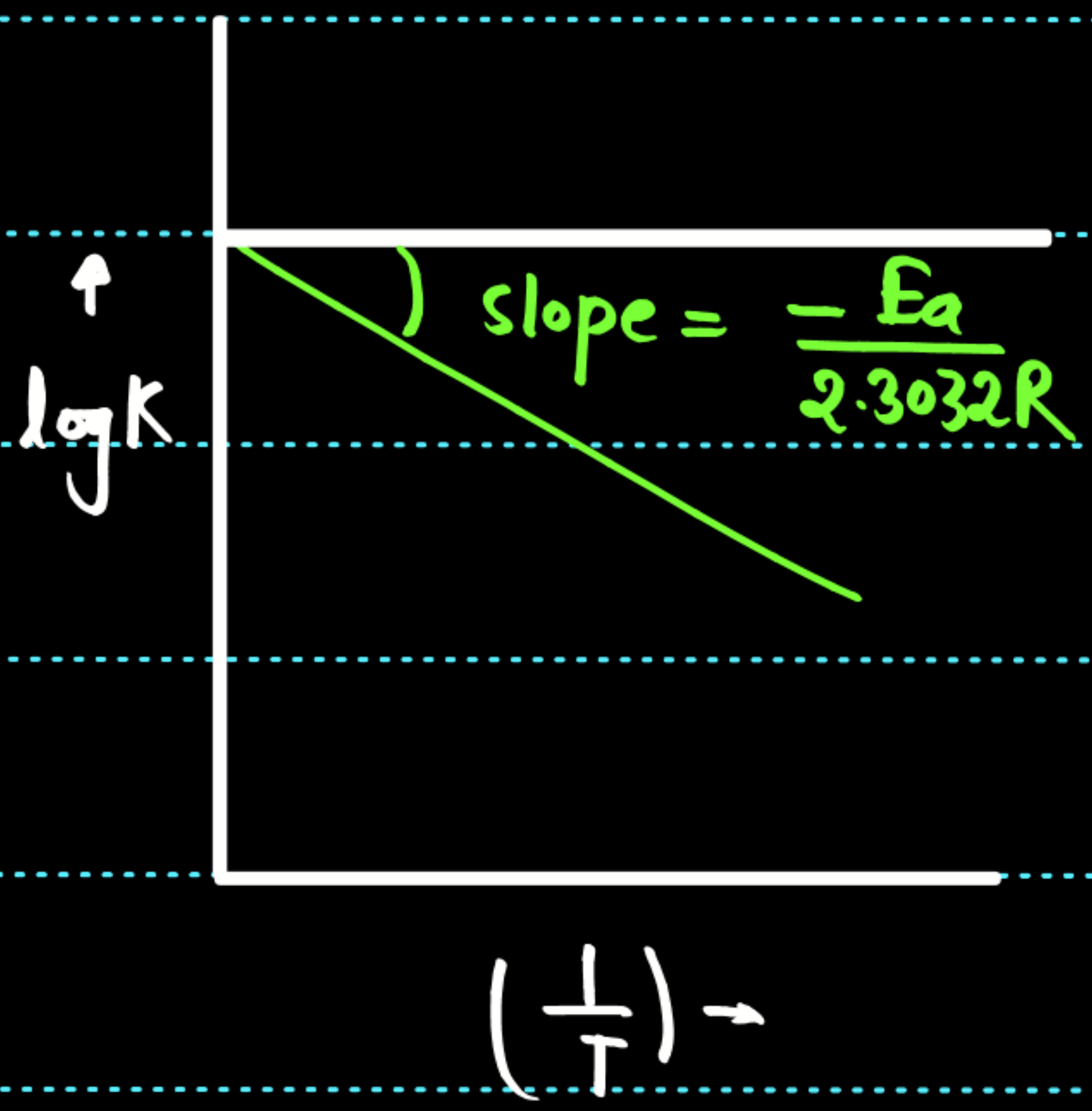
$$y = -m x + c$$



$$2.303 \log K = -\frac{E_a}{R}\left(\frac{1}{T}\right) + 2.303 \log A$$

$$\log K = -\frac{E_a}{2.3032R}\left(\frac{1}{T}\right) + \log A$$

$$y = -m\,x + C$$



$T_1 \rightarrow k_1 \Rightarrow k_1 = A e^{-\frac{E_a}{RT_1}}$ —— ①

$T_2 \rightarrow k_2 \Rightarrow k_2 = A e^{-\frac{E_a}{RT_2}}$ —— ②

→ $T_1 < T_2$

$\frac{②}{①} \Rightarrow \frac{k_2}{k_1} = e^{-\frac{E_a}{RT_2} + \frac{E_a}{RT_1}}$

$$\frac{k_2}{k_1} = e^{\frac{Ea}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)}$$

$$\ln\frac{k_2}{k_1} = \ln_e e^{\frac{Ea}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)}$$

$$\ln\frac{k_2}{k_1} = \frac{Ea}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)\ln_e e$$

$$\boxed{\ln\frac{k_2}{k_1} = \frac{Ea}{R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)}$$

Q

$$\log K = -\frac{0.23032}{T} + 0.587$$

given Relation b/w K and T

Calculate Ea

$$\log K = -\frac{E_a}{2.3032R}\left(\frac{1}{T}\right) + \log A$$

a) 10R

b) R/10

c) R

d) NONE

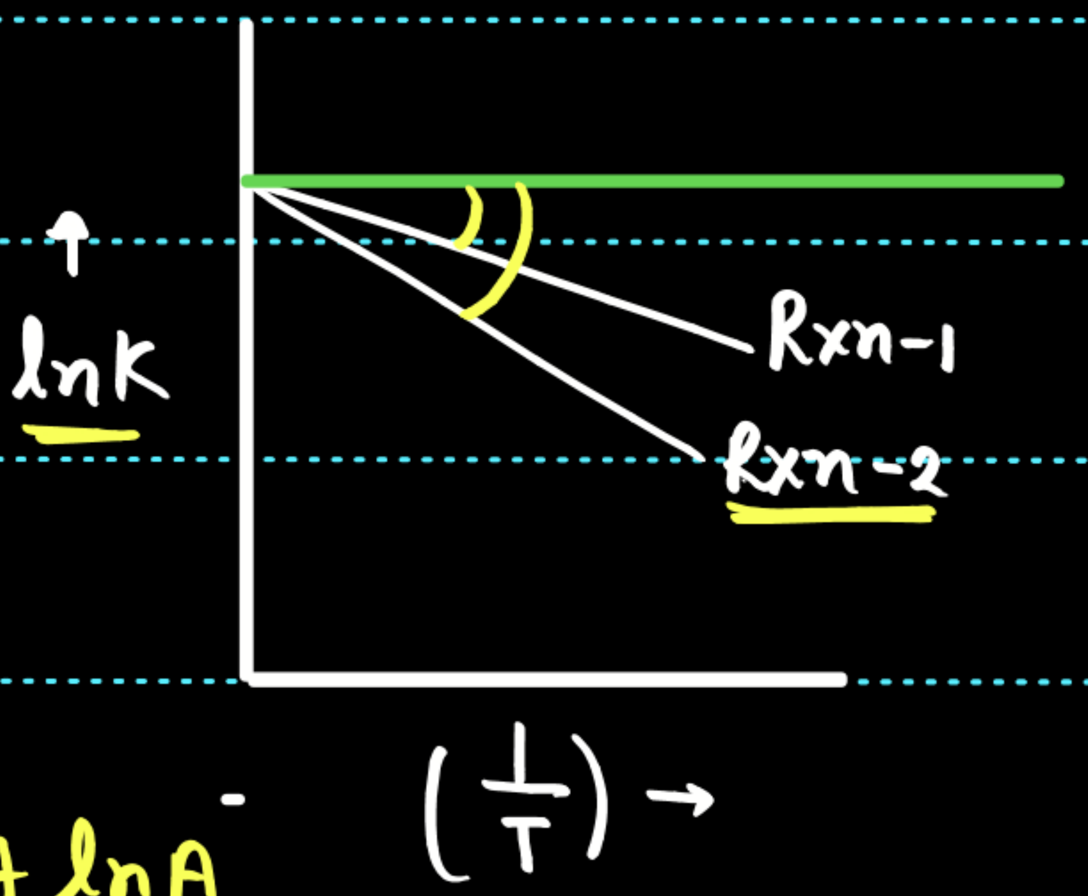
$$+\frac{E_a}{2.303R} = +0.23032$$

$$E_a = 2.3032 \times 0.23032 \times R \text{ Joule}$$

Q Reaction-1 → $(E_a)_1$

Reaction-2 → $(E_a)_2$

Select Correct Relation b/w Activation Energy of Rxn-1 and Rxn-2



a) $(E_a)_1 > (E_a)_2$

b) $(E_a)_1 = (E_a)_2$

c) $(E_a)_1 < (E_a)_2$ ✓

d) Can not say

$$\ln K = -\frac{E_a}{R}\left(\frac{1}{T}\right) + \ln A$$

$$\text{Slope} = -\frac{E_a}{R} \qquad \cancel{-}0.15 = \cancel{-}\frac{E_a}{R}$$

$$\text{Slope} \propto E_a$$

CSD $K = A e^{-E_a/RT}$

→ Activation Energy = Min. required Energy to reach Activatⁿ Complex

→ $E_a \neq 0$, $E_a \neq -ve$

→ E_a depend upon temp. theoretically

→ $\Delta H = (E_a)_f - (E_a)_b$

→ $\Delta H = +ve \rightarrow (E_a)_f > (E_a)_b$

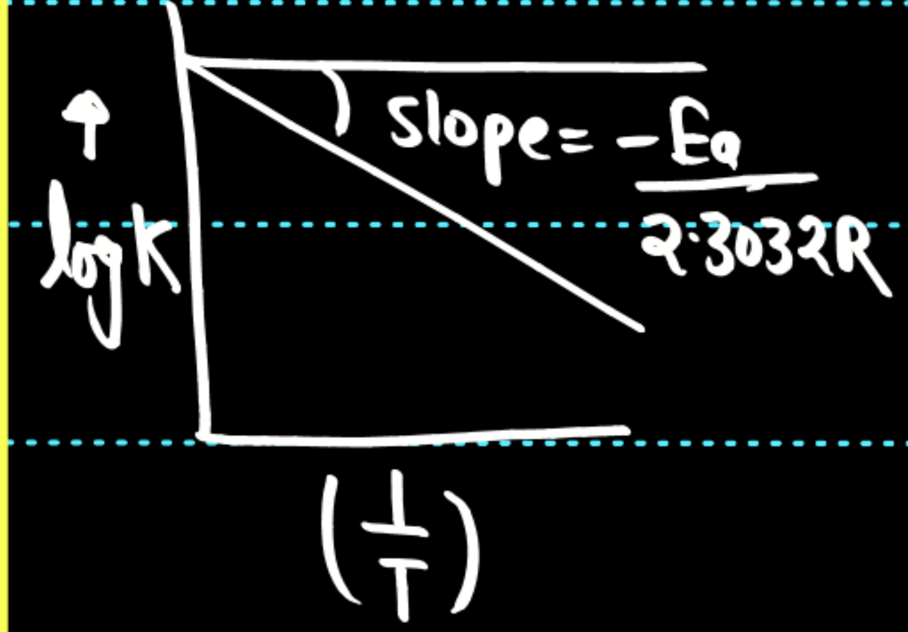
→ $\Delta H = -ve \rightarrow (E_a)_f < (E_a)_b$

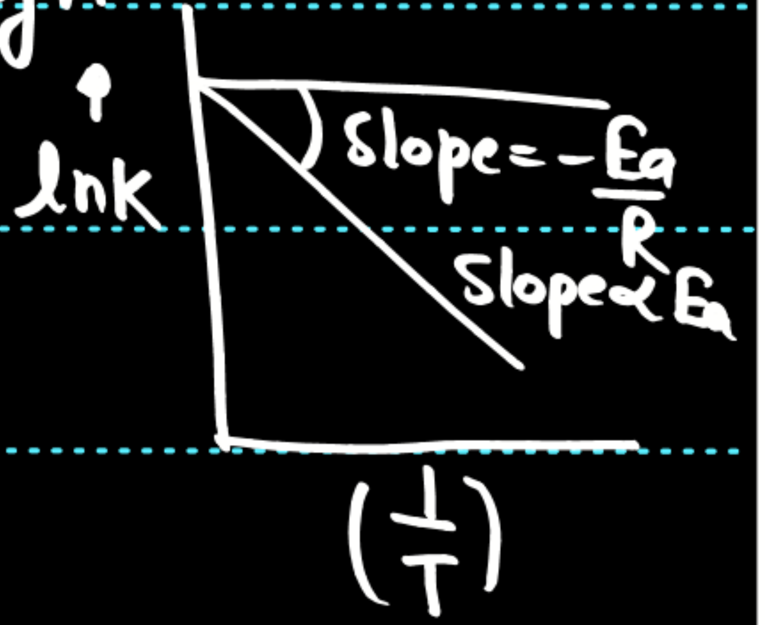
→ Catalyst effect Activation Energy

→ decrease

→ $\ln K = -\frac{E_a}{R}\left(\frac{1}{T}\right) + \ln A$

→ $\log K = \frac{-E_a}{2.3032R}\left(\frac{1}{T}\right) + \log A$





$\Delta H = +ve$

Q14. For an endothermic reaction, energy of activation is E_a and enthalpy of reaction is ΔH (both of these in kJ/mol). Minimum value of E_a will be

[CBSE AIPMT 2010]

(a) less than ΔH (b) equal to ΔH

(c) more than ΔH (d) equal to zero

$$\Delta H = (E_a)_f - (E_a)_b$$

$\Delta H \rightarrow +ve$

$$(E_a)_f = \Delta H + (E_a)_b$$

$$(E_a)_f > \Delta H$$

Q30. The activation energy for a simple chemical reaction, $A \rightarrow B$ is E_a in forward direction. The activation energy for reverse reaction

[CBSE AIPMT 2003]

(a) can be less than or more than E_a (b) is always double of E_a

(c) is negative of E_a (d) is always less than E_a

$$\Delta H = (E_a)_f - (E_a)_b$$

$$(E_a)_b = (E_a)_f - \Delta H$$

$$\Delta H = +ve \rightarrow (E_a)_b < (E_a)_f$$

$$\Delta H = -ve \rightarrow (E_a)_b > (E_a)_f$$

Q41. In a reversible reaction, the energy of activation of the forward reaction is 50 kcal. The energy of activation for the reverse reaction will be

[CBSE AIPMT 1996]

(a) < 50 kcal (b) 50 kcal

(c) either greater than or less than 50 kcal (d) > 50 kcal

$\Delta H = (E_a)_f - (E_a)_b$

$\Delta H = 50 - (E_a)_b$

$(E_a)_b = 50 - \Delta H$

→ endo ($\Delta H = +ve$) → $(E_a)_b < 50$

→ exo ($\Delta H = -ve$) → $(E_a)_b > 50$

TATVA → PDF → Free

(Ex-1), 1 to 52 Question

MANTHAN NEET 2025

CHEMISTRY

chemical kinetics

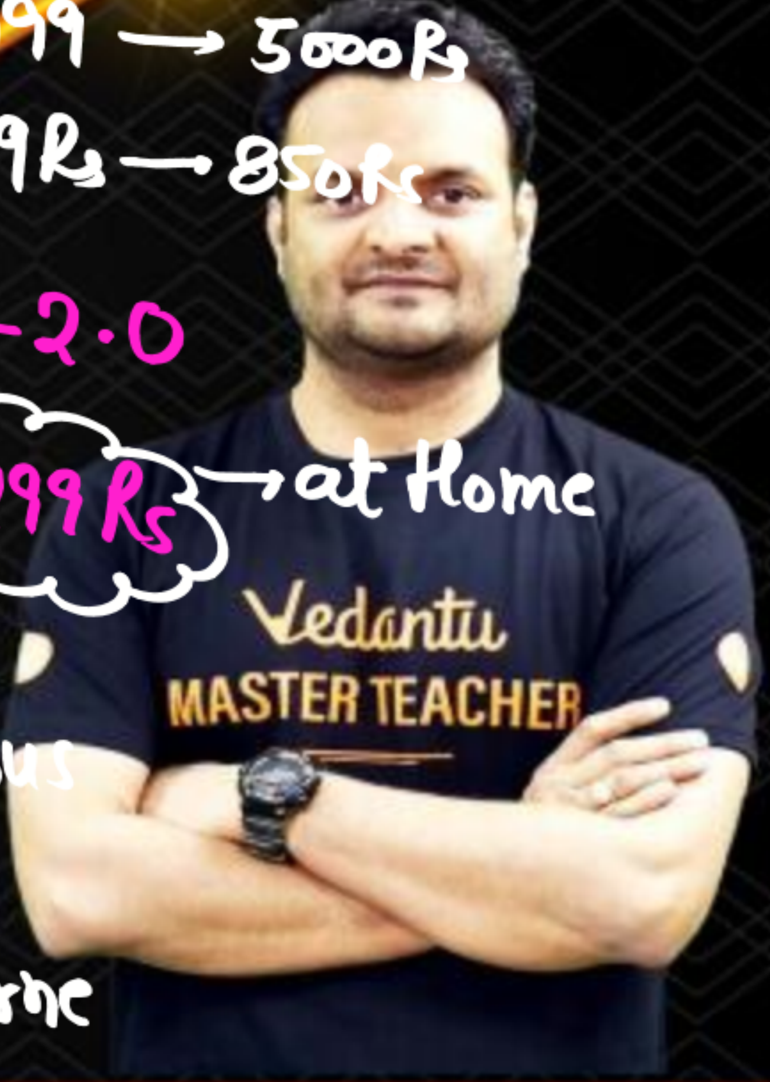
Lecture-08

5999 → 5000Rs
999Rs → 850Rs

NYTS-2.0

~~1999~~ → 1499 Rs → at Home

→ Revision-ubar syllabus
→ Silly mistake
→ No. impoove krne



Sarvesh Sir

Qsd-1 If $\ln k$ Vs $\frac{1}{RT}$ graph draw in figure

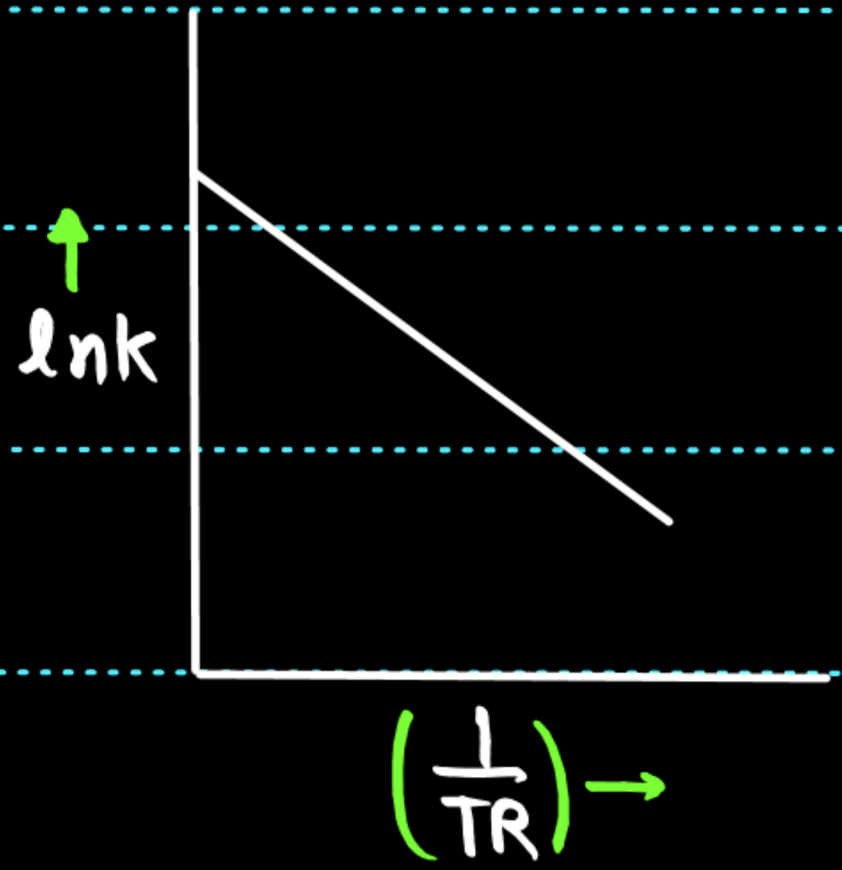
Calculate slope

a) $-\frac{E_a}{R}$

c) $-E_a \times R$

b) $-E_a$

d) NONE



$$\ln k = -\frac{E_a}{RT} + \ln A$$

$$\underbrace{\ln k}_{y} = \underbrace{-E_a}_{-m}\underbrace{\left(\frac{1}{RT}\right)}_{x} + \underbrace{\ln A}_{c}$$

$$y = -m\,x + c$$

Qsd-2 A → B

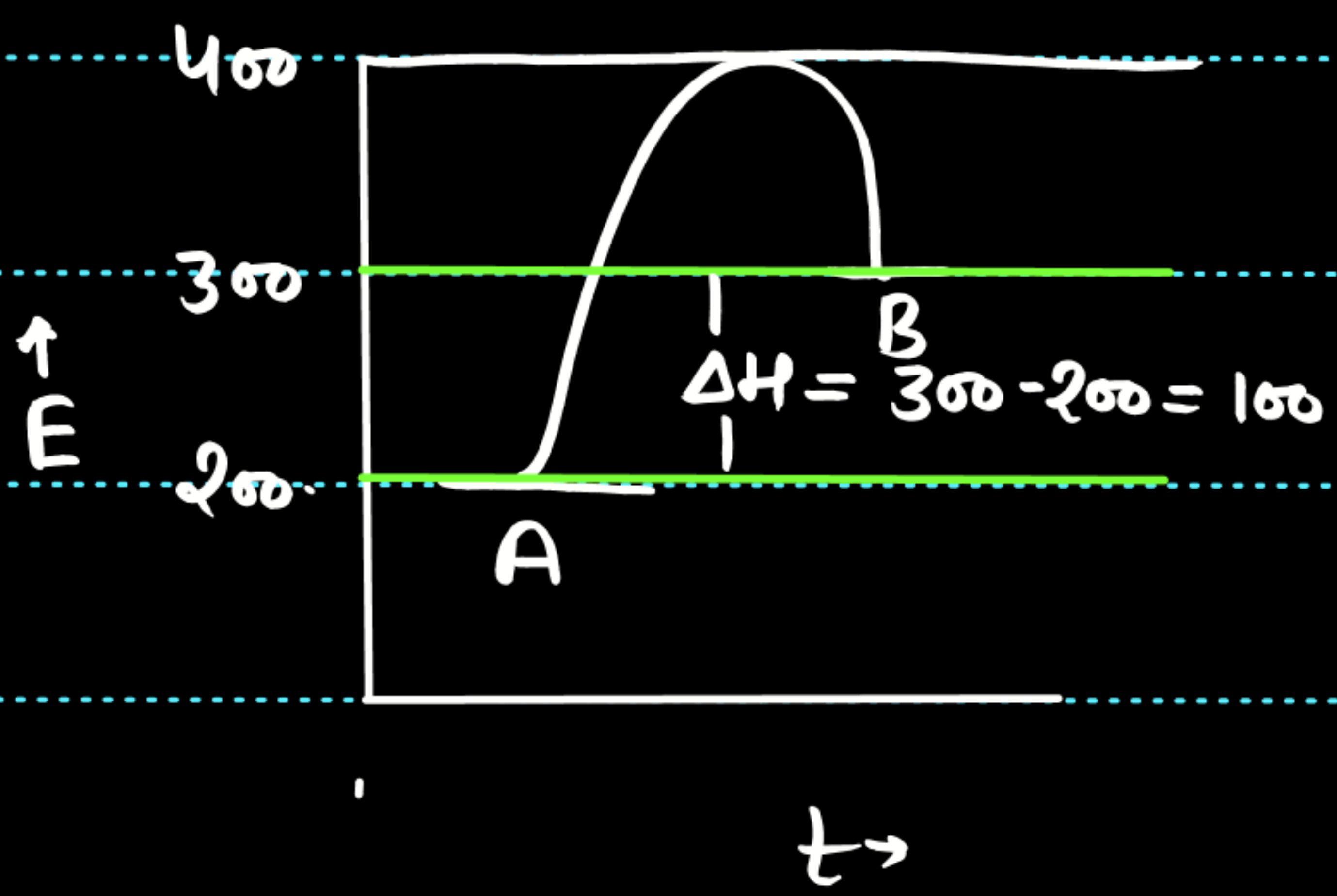
Calculate Heat of Rxn

a) 200

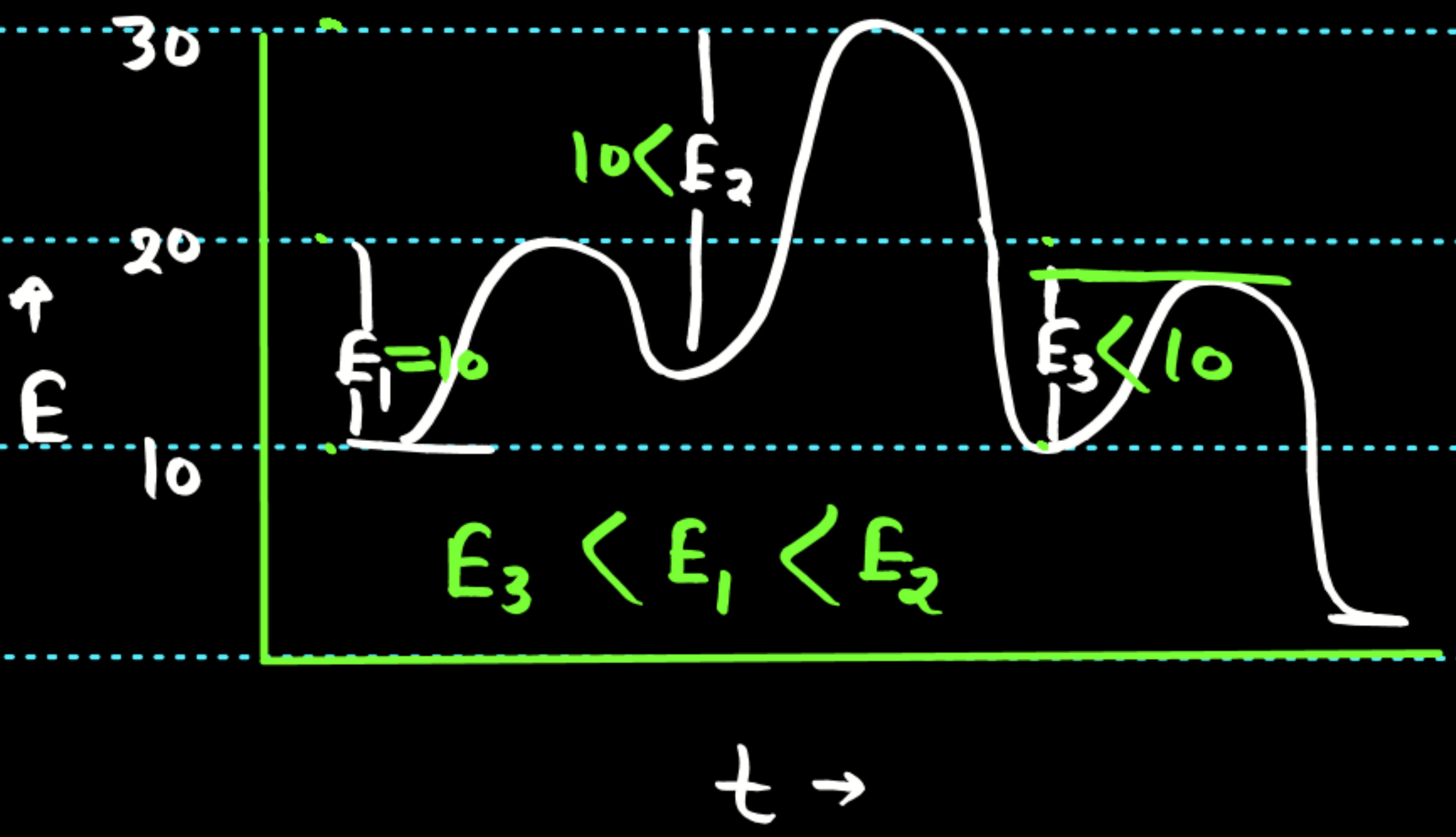
b) 100 ✓

c) 300

d) NONE



Qsd-3



a) $E_1 < E_3 < E_2$

b) $E_3 < E_1 < E_2$ ✓

c) $E_1 = E_3 < E_2$

d) NONE

$\frac{?}{3}$

above energy digram is given Rxn A ⟶ B

Select order of Activation energy of given step

Arrhinus Equation

$$\ln \frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$20 > 10$

$\frac{1}{20} < \frac{1}{10}$

$$2.3032 \log \frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

→ $T_2 > T_1$

→ $\frac{1}{T_2} < \frac{1}{T_1}$

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.3032R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

+ve +ve

→ $\log x = +ve$

$x > 1$

$\log \frac{k_2}{k_1} = +ve \Rightarrow \frac{k_2}{k_1} > 1 \Rightarrow k_2 > k_1$

$R.O.R = K$

$$\boxed{R = K}$$

Q → $A \longrightarrow B \rightarrow E = ?$

Mech. $A \xrightarrow{K_1} A^* \rightarrow E_1 = 80$

$A^* \xrightarrow{K_2} B \rightarrow E_2 = 60$

Calculate overall Activation Energy of Rxn. and overall Rate Const is $K = \sqrt{\frac{K_1}{K_2}}$

13:3

13:3

$$K = K_1^{x} \cdot K_2^{y} \cdot K_3^{z} \cdots$$

$$\rightarrow K = \sqrt{\frac{K_1}{K_2}} = K_1^{\frac{1}{2}} \cdot K_2^{-\frac{1}{2}}$$

$$(E_a)_{overall} = x \times (E_a)_1 + y \times (E_a)_2 + z\,(E_a)_3 + \cdots$$

$$E_a = \frac{1}{2} \times 80 - \frac{1}{2} \times 60 = 40 - 30 = 10$$

Q $P \rightarrow Q$

Mech → $P \rightarrow P^*$ $E_1 = 100$

$P^* \rightarrow Q$, $E_2 = 60$

Overall Rate Const of Rxn is $K = \frac{K_1^{3/2}}{K_2}$

Calculate overall Activation energy

a) 90 b) 150 c) 40 d) NONE

$K = K_1^{3/2} \cdot K_2^{-1}$

$E_a = \frac{3}{2} \times 100 - 1 \times 60$

$= 150 - 60$

$= 90$

Temperature Coefficient (μ_T)

Temp. Coefficient is equal to Ratio of Rate Const at (T+10)K and TK

$$\mu_T = \frac{K_{T+10}}{K_T}$$

→ generally Rate of rxn double in each 10°C rise in temperature

Q → 20°C at Rate Const is $1.5\times10^{+3}$ and 30°C is 4.5×10^{3}, Calculate temp. Coefficient

$$\mu_T = \frac{K_{30}}{K_{20}} = \frac{4.5\times10^{3}}{1.5\times10^{3}} = 3$$

$$\mu_T = \frac{K_{T+10}}{K_T} = \frac{A e^{-E_a/R(T+10)}}{A e^{-\frac{E_a}{RT}}}$$

$$\mu_T = e^{-\frac{E_a}{R(T+10)} + \frac{E_a}{RT}}$$

$$\mu_T = e^{\frac{E_a}{R}\left(\frac{1}{T} - \frac{1}{T+10}\right)}$$

$$\ln \mu_T = \frac{E_a}{R}\left(\frac{1}{T} - \frac{1}{T+10}\right)$$

Effect of catalyst in Activation energy

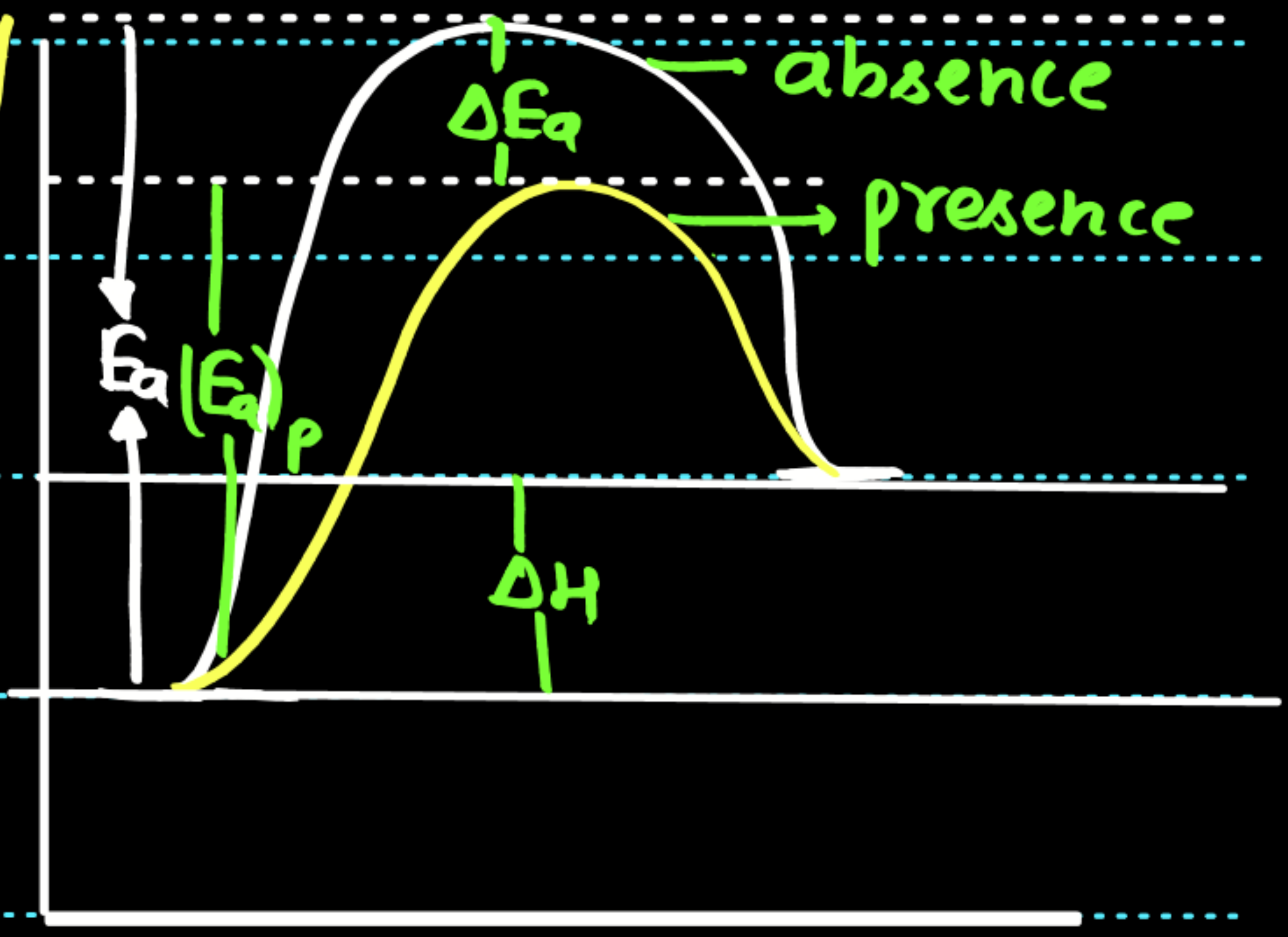
In presence of catalyst, Activation energy decrease

→ ΔH (Heat of rxn) → NO effect

$\Delta E_a = E_a - (E_a)_p$

$K_a = A e^{-E_a/RT}$ → absence

$k_p = A e^{-E_p/RT}$ → presence



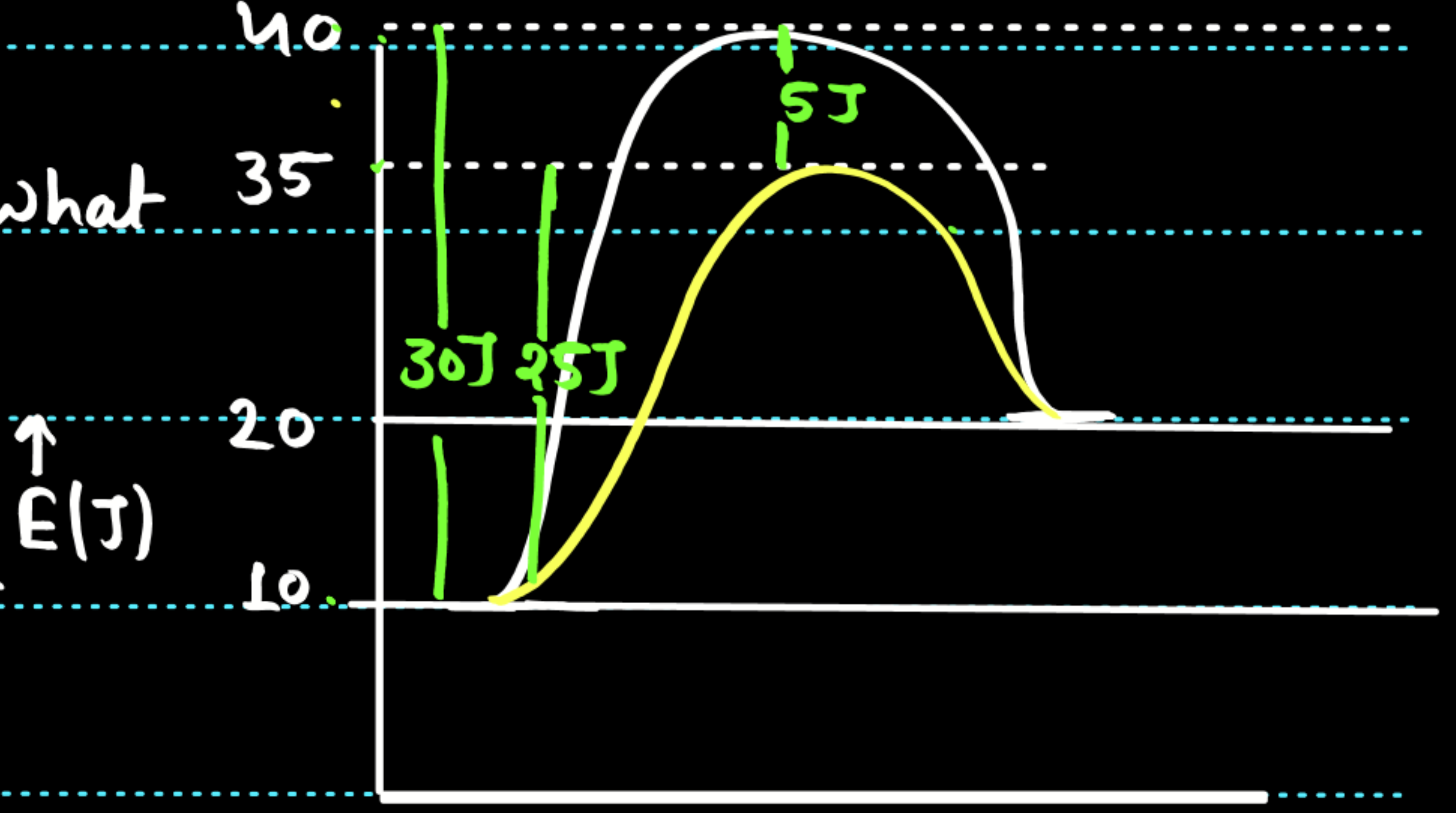
$$\frac{K_a}{K_p} = e^{-\frac{E_a}{RT} + \frac{E_p}{RT}}$$

$$\frac{K_a}{K_p} = e^{\frac{1}{RT}\left(E_p - E_a\right)} \Rightarrow \frac{K_p}{K_a} = e^{\frac{1}{RT}\left(E_a - E_p\right)}$$

$$\Delta E_a = E_a - E_p$$

$$\boxed{\frac{k_p}{k_a} = e^{\frac{\Delta E_a}{RT}}}$$

Q in given diagram white line and yellow line show energy diagram in absence and presence catalyst. what amount of Activation energy decreases in presence of catalyst



a) 10J

b) 5J ✓

c) 20J

d) 15Joule

CSD ① $\ln \frac{K_2}{K_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

② $\log \frac{K_2}{K_1} = \frac{E_a}{2.303\,2R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

③ Rate of rxn increases in increasing of temperature

④ Arrhinus Eq. applicable for zero order Rxn

Rate = K

$T_1 K \longrightarrow K_1 \longrightarrow R_1$

$T_2 K \longrightarrow K_2 \longrightarrow R_2$

$\left[\frac{K_2}{K_1} = \frac{R_2}{R_1}\right]$

⑤ $\log \frac{R_2}{R_1} = \frac{E_a}{2.303\,2R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

⑥ → If overall Rate Const given in term of mechanism each step Rate Const → $K = K_1^x \cdot K_2^y \cdot K_3^z \cdots$

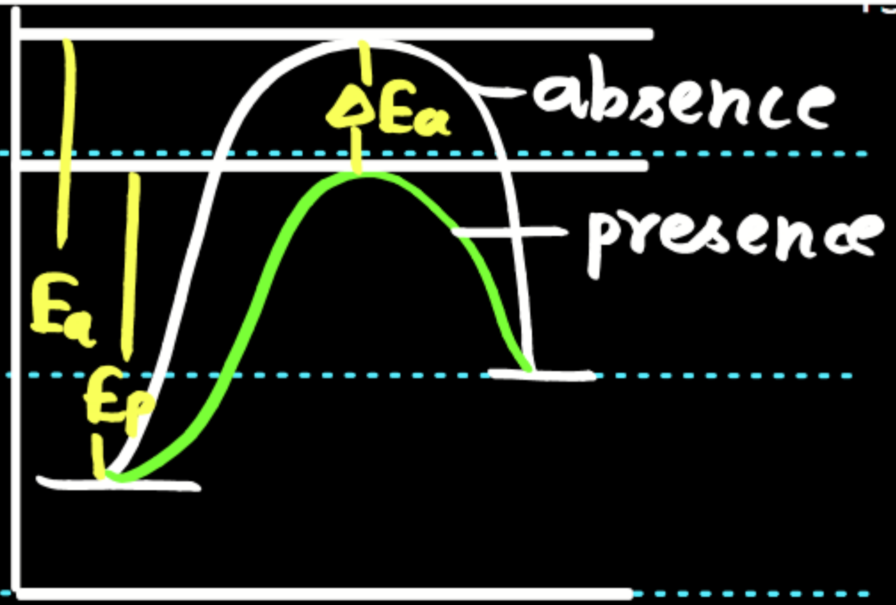
$(E_a)_{overall} = x \times E_1 + y E_2 + z E_3 + \cdots$

CSP → $\mu_T = \frac{K_{T+10}}{k_T}$

→ In general Rate of rxn increases 2 times approx, in every 10°C rise in temp.

→ $\ln \mu_T = \frac{E_a}{R}\left(\frac{1}{T} - \frac{1}{T+10}\right)$

Effect of Catalyst = Rate of rxn increases because Activation energy decrease



→ Heat of rxn (ΔH) not effect by catalyst

$\Delta E_a = E_a - E_p$

$$\frac{K_p}{K_a} = e^{\frac{\Delta E_a}{RT}}$$

Where → K_p and K_a Rate Const presence and absence of Catalyst

Q9. What is the activation energy for a reaction if its rate doubles when the temperature is raised from 20ºC to 35ºC? ($R = 8.314\ J\ mol^{-1}\ K^{-1}$)

[NEET 2013]

(a) $342\ kJ\ mol^{-1}$ (b) $269\ kJ\ mol^{-1}$

(c) $34.7\ kJ\ mol^{-1}$ (d) $15.1\ kJ\ mol^{-1}$

$E_a = 34.673\ KJ/mole$

$273 + 20^\circ C \rightarrow R$

$35^\circ C \rightarrow 2R$

$$\log \frac{R_2}{R_1} = \frac{E_a}{2.3032R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\log \frac{2R}{R} = \frac{E_a}{2.3032R}\left(\frac{1}{293} - \frac{1}{308}\right)$$

$$2.3032 \log 2 \times R = E_a \times \left(\frac{308-293}{293 \times 308}\right)$$

$$E_a = \frac{0.6932 \times 8.314 \times 10^{-3}}{15} \times 293 \times 308$$

Q11. In a zero order reaction for every 10ºC rise of temperature, the rate is doubled. If the temperature is increased from 10ºC to 100ºC, the rate of the reaction will become

[CBSE AIPMT 2012]

(a) 256 times

(b) 512 times

(c) 64 times

(d) 128 times

10 → 20 → 30 → 40 → 50 → 60 → 70 → 80 → 90 — 100

×2, 2×2, 8, 16, 32, 64, 128, 256, 512

Q20. The rate constants k_1 and k_2 for two different reactions are $10^{16} \cdot e^{-2000/T}$ and $10^{15} \cdot e^{-1000/T}$, respectively. The temperature at which $k_1 = k_2$ is

[CBSE AIPMT 2008]

(a) 1000 K

(b) $\frac{2000}{2.303}$K

(c) 2000K

(d) $\frac{1000}{2.303}$K

$$\frac{e^{-1000/T}}{e^{-2000/T}} = e^{-\frac{1000}{T}+\frac{2000}{T}}$$

$\ln e$

$k_1 = k_2$

$$\frac{10^{16}}{10^{15}} = 10$$

$$10^{16} e^{-\frac{2000}{T}} = 10^{15} e^{-\frac{1000}{T}}$$

$$10 = e^{-\frac{1000}{T}+\frac{2000}{T}}$$

$$\ln 10 = -\frac{1000}{T} + \frac{2000}{T}$$

$$2.3032 \log 10 = \frac{1000}{T}$$

$$T = \frac{1000}{2.3032} K$$

Q32. The temperature dependence of rate constant (k) of a chemical reaction is written in terms of Arrhenius equation, $k = Ae^{-E*/RT}$. Activation energy (E*) of the reaction can be calculated by plotting

[CBSE AIPMT 2003]

(a) $\log k$ vs $\frac{1}{T}$ → slope = $\frac{-Ea}{2.3032R}$

(b) $\log k$ vs $\frac{1}{\log T}$

(c) k vs T

(d) k vs $\frac{1}{\log T}$

Q45. For exothermic reaction, the energy of activation of the reactants is

$\Delta H = -ve$

[CBSE AIPMT 1994]

(a) equal to the energy of activation of products

(b) less than the energy of activation of products

(c) greater than the energy of activation of products

(d) Sometimes greater an sometimes less than that of the products

$$\Delta H = (E_a)_f - (E_a)_b$$

$$(E_a)_f = \underset{-ve}{\Delta H} + \underset{+ve}{(E_a)_b}$$

$$(E_a)_f > (E_a)_b$$

Q30. The activation energy for a simple chemical reaction, $A \rightarrow B$ is E_a in forward direction. The activation energy for reverse reaction

[CBSE AIPMT 2003]

(a) can be less than or more than E_a (b) is always double of E_a

(c) is negative of E_a (d) is always less than E_a

$$(E_a)_f = \Delta H + (E_a)_b$$

$\Delta H \downarrow$ + / −

Q → Activation energy of a zero order rxn decrease 10 Joule in presence of catalyst, Calculate $\ln \frac{K_p}{K_a}$ value at 300K temp.

(Where K_p & K_a = Rate Const presence and absence of catalyst)

Soln →

$$\frac{K_p}{K_a} = e^{\frac{\Delta E_a}{RT}}$$

$$\ln \frac{K_p}{K_a} = \frac{\Delta E_a}{RT} = \frac{10}{8.314 \times 300}$$

MANTHAN NEET 2025

CHEMISTRY

chemical kinetics

Lecture-09

Syllabus → 1 Step-2024 test

Complete chemical Kinetics



Sarvesh Sir

Qsd-01. In a reversible endothermic reaction , the energy of activation of the forward reaction is 50 kcal. The energy of activation for the reverse reaction will be

[CBSE AIPMT 1996]

F.Y.Q

(a) < 50 kcal (b) 50 kcal

(c) either greater than or less than 50 kcal (d) > 50 kcal

$$\Delta H = (E_a)_f - (E_a)_b$$

$$(E_a)_b = (E_a)_f - \Delta H$$

$(E_a)_f$ → +ve, ΔH → +ve

$$(E_a)_b < (E_a)_f$$

Qsd-02. A chemical reaction is catalysed by a catalyst X, Hence X

[CBSE AIPMT 1995]

F.Y.Q.

(a) reduces enthalpy of the reaction ✗

(b) decreases rate of reaction of the reaction ✗

(c) increases activation energy of the reaction

(d) decreases activation energy of the reaction ✓

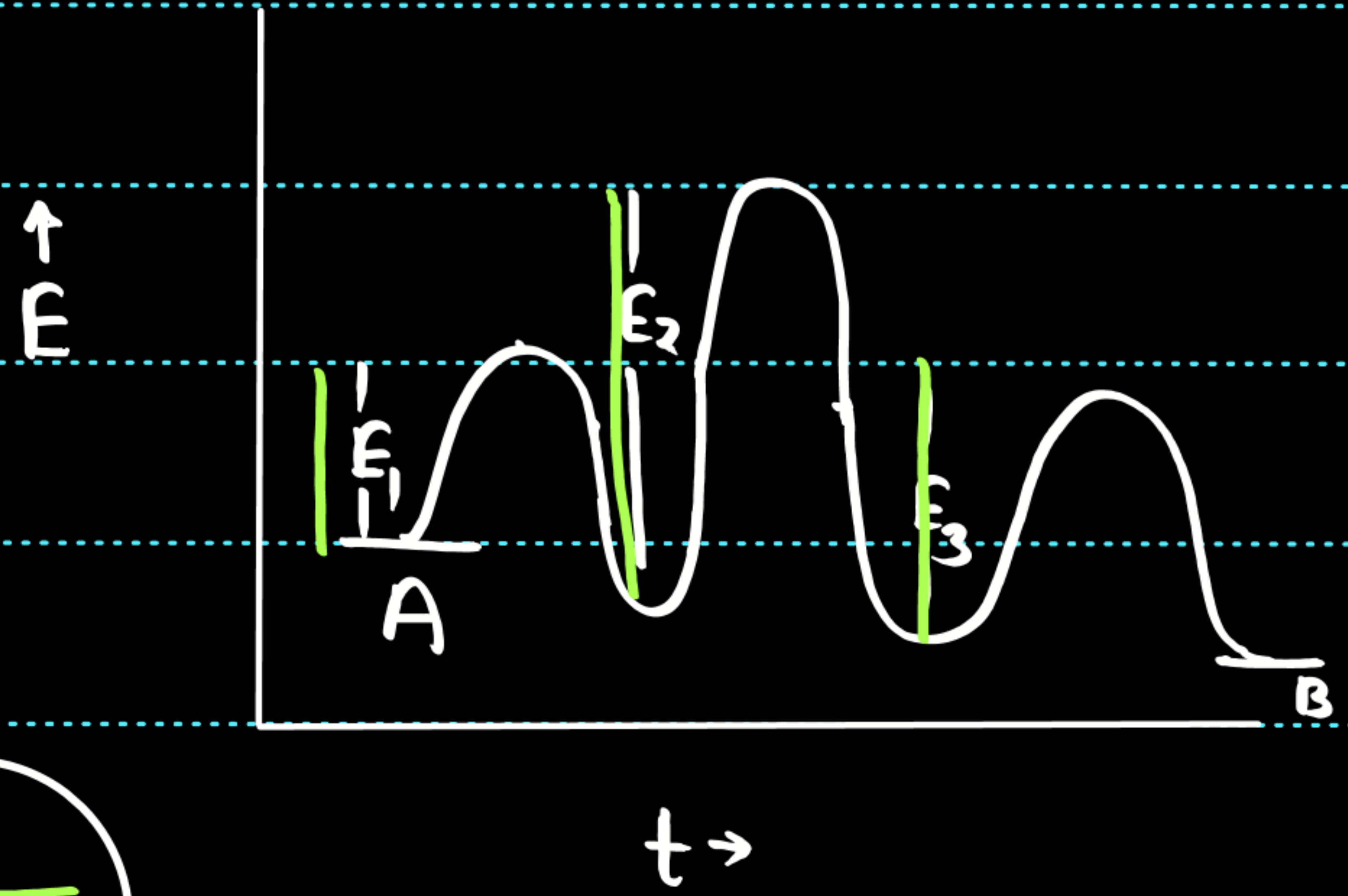
Qsd-3

Select max. value of Activation energy in individual step

1) E_1
2) E_2 ✓
3) E_3
4) All Equal

$E_2 > E_3 > E_1$

$\frac{?}{3}$



Collision theory

Reaction occurs due to collision

Rate of rxn depend upon mainly 2-factor

1) Orientation factor (Perfect collision)

2) Energy factor

Rate of reaction = Collision factor x Energy factor

$$K = P \times Z \times e^{-Ea/RT}$$

Only applicable for zero order rxn (R.O.R. = K)

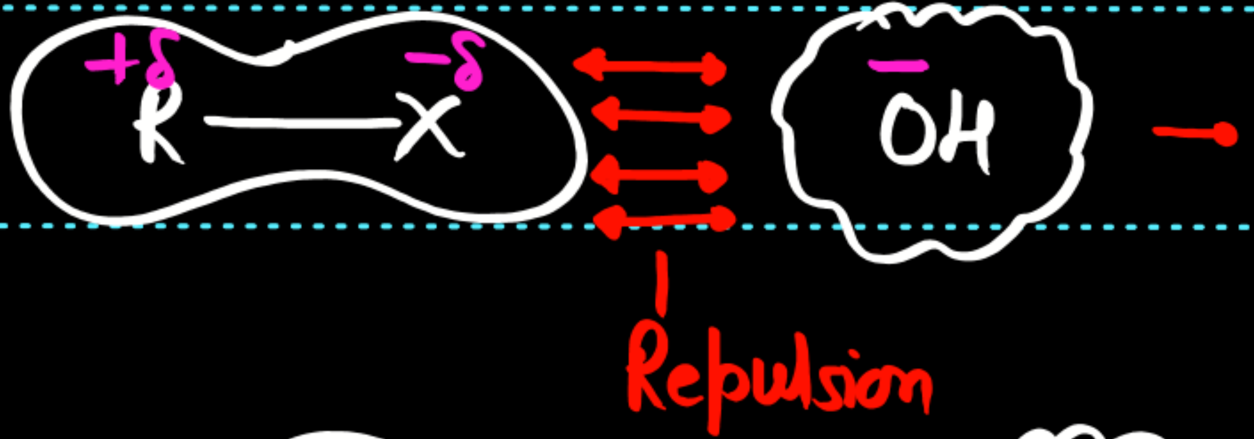
1. **Collision factor** total No. of effective collision between Reactant molecules which is convert into product

Collision

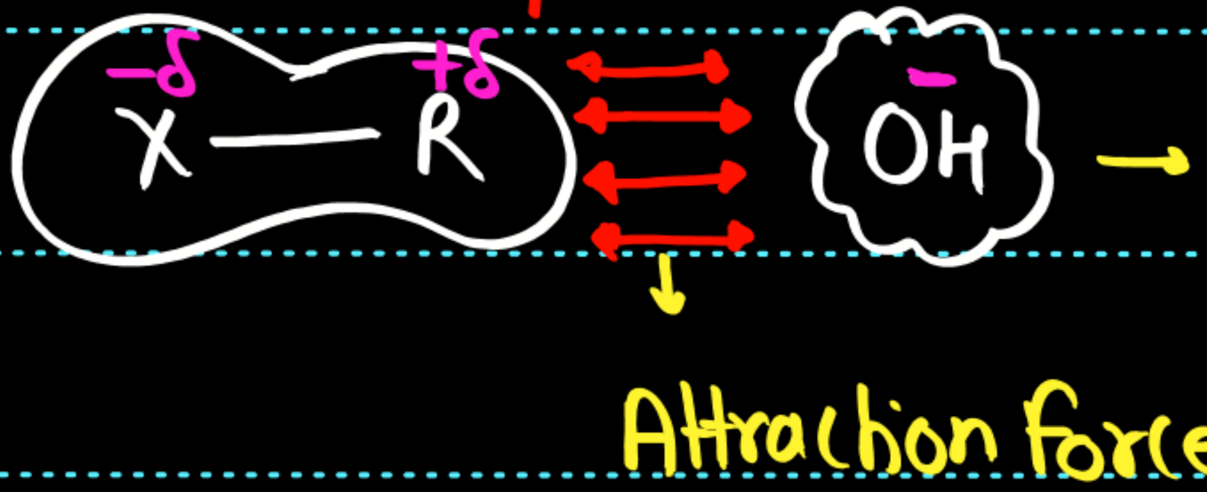
Effective collision	uneffective collision
→ Orientation proper hota hai	unproper orientation
→ Perfect Collision	→ does not form product
→ form product	→ nonperfect Collision

S_N2 Reaction

$$R-X + \bar{O}H \longrightarrow R-OH + X^-$$



Collision → No product



Collision → product

total No. of Collision is 'Z'

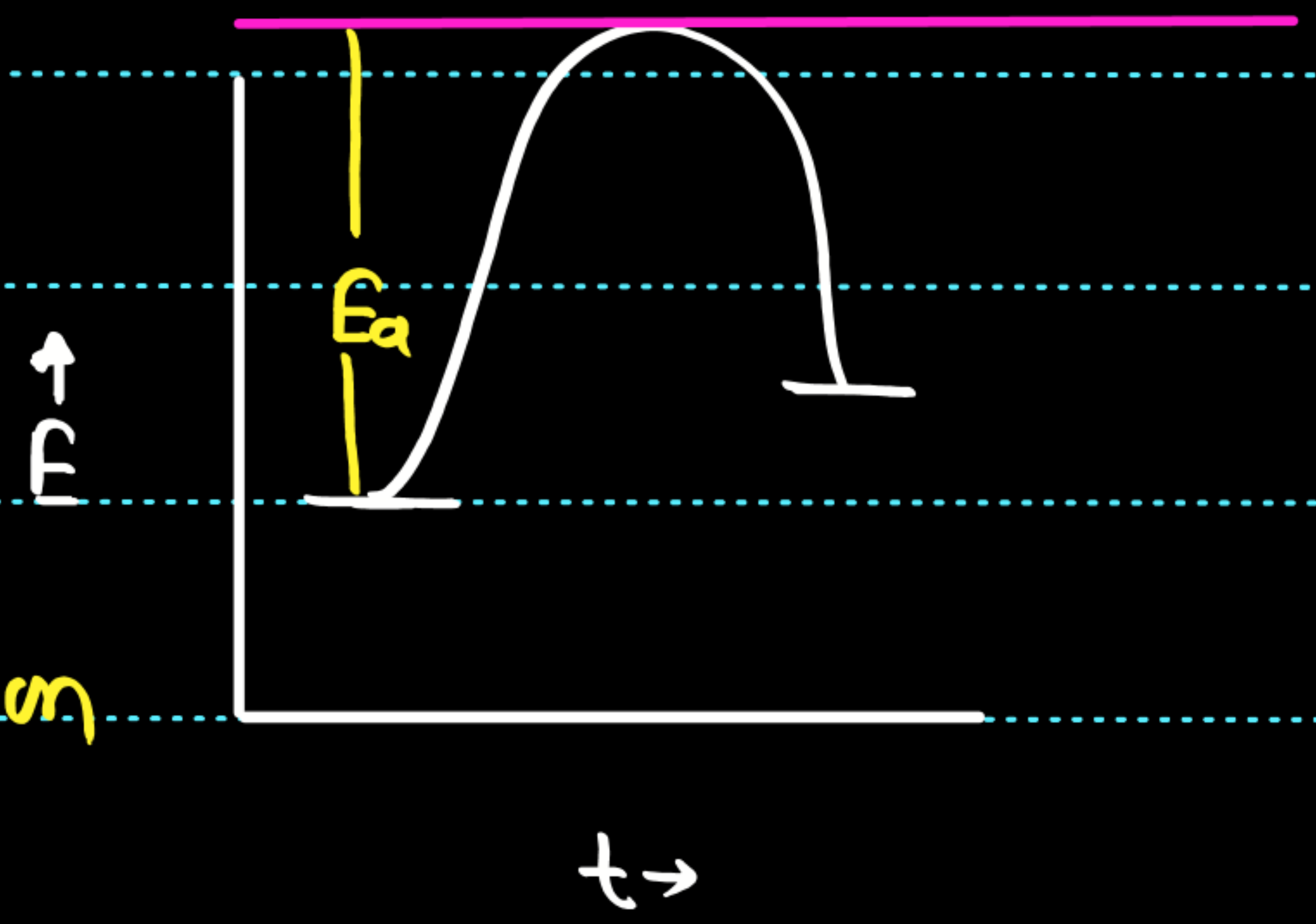
total No. of effective Collision is $Z \times P$

where p = probability of effective collision

$$\boxed{P < 1}$$

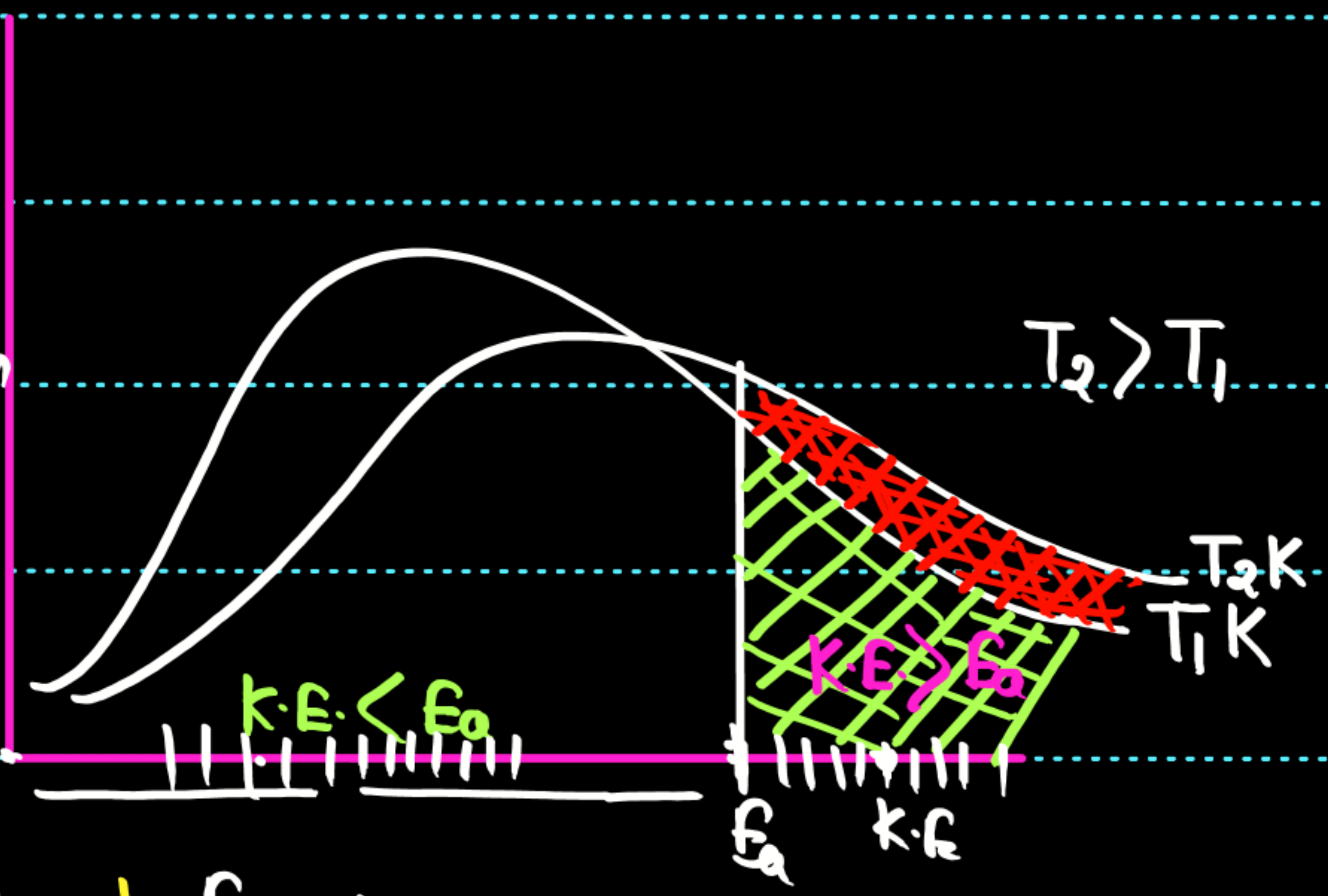
2) Energy factor

total No. of molecules which have Kinetic energy greater than Activation energy of Reaction is $\boxed{e^{-E_a/RT}}$



temperature $\propto$ Rate of reaction   fraction of effective collision molecules ↑

Reason = total No. of Molecules which have K.E greater than E_a increases in increasing of temperature



total Area = Constant → only effective collision Ke number increase hue hai

Q Select Correct statements

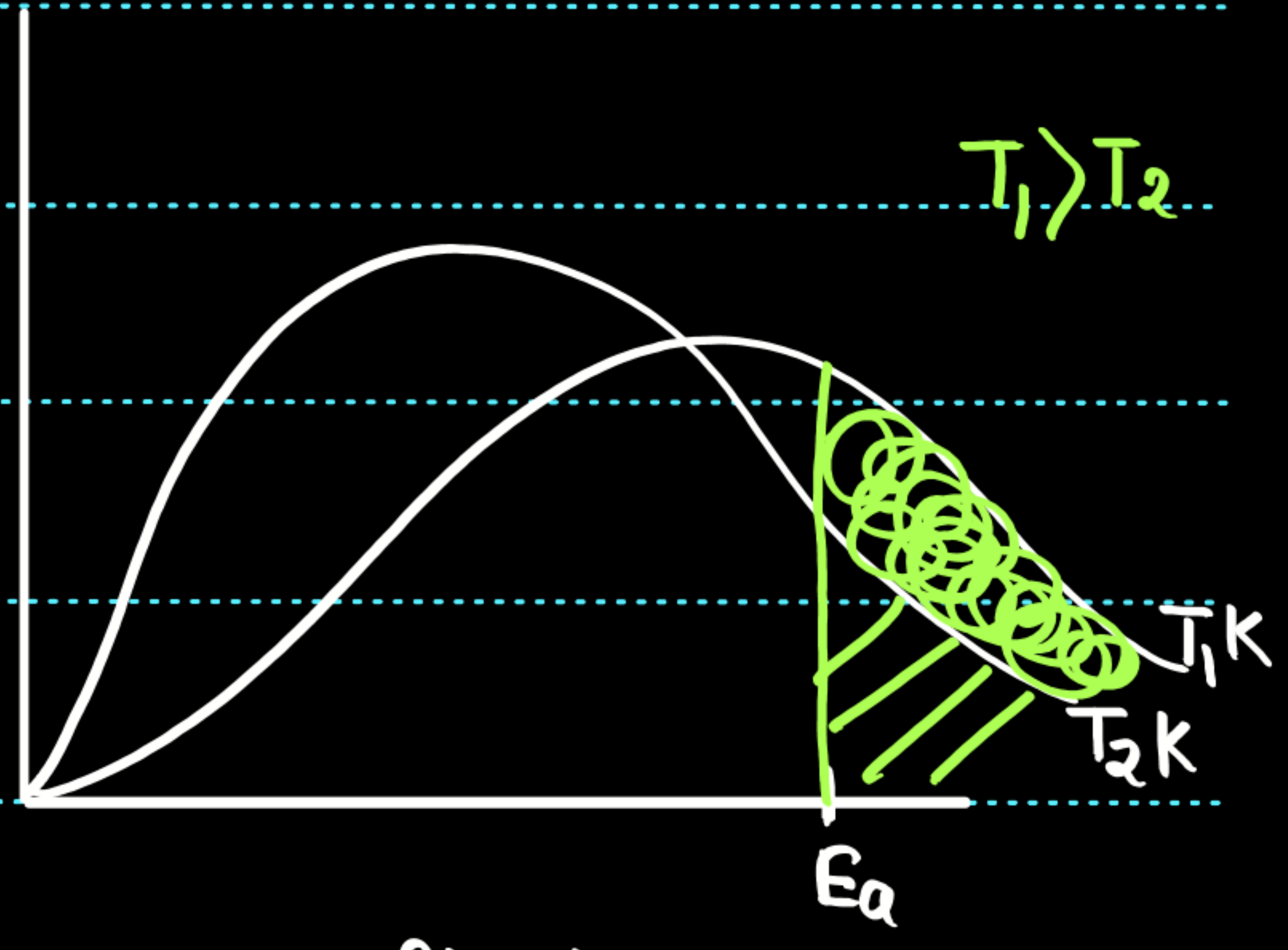
a) Rate of rxn at $T_1 K$ is greater than Rate of rxn at $T_2 K$

b) Rate of rxn at $T_1 K$ is less than Rate of rxn at $T_2 K$

c) Rate of rxn at $T_1 K$ is equal than Rate of rxn at $T_2 K$

d) NONE

No. of effective Collision molecules ↑



Determination of Order of Reaction, when Reaction mechanism is given

Q → $2A \longrightarrow B$

Mech $A \longrightarrow A^*$ (slow)

$A + A^* \longrightarrow B$ (fast)

1) slow step method
2) Study state approximation method

1) 1^{st} step = Slow step

Step=1 → Select slow step

Step-2 → Write Rate law Expression

Equation of slow step

$$Rate = K[A_t]^n$$

Step-3 → Write Relation b/w R.O.R and individual Rate

2) 2^{nd} step = Slow step

Step=1 → Select slow step

Step-2 → Write Rate law Expression

Equation of slow step

$$Rate = K[A_t]^n$$

Step=3 → R.O.R. intermediate Ke term me nahi likha jata hai, So aap Ko inter-mediate Ki value likal Kr (1^{st} step se)

Rate law Expression me put kr donge.

Step=4 write Relation b/w R.O.R and individual Rate

Q → $2NO_2 + \frac{1}{2}O_2 \longrightarrow N_2O_5$

Mech:

✓ $2NO_2 \longrightarrow N_2O_4$ (slow)

$N_2O_4 + \frac{1}{2}O_2 \longrightarrow N_2O_5$ (Fast)

Solution

$$R.O.R. = k[NO_2]^2$$

$$R.O.R. = -\frac{1}{2}\frac{dNO_2}{dt} = \frac{-1}{\frac{1}{2}}\frac{dO_2}{dt} = -2\frac{dO_2}{dt} = +\frac{1}{1}\frac{dN_2O_5}{dt}$$

order of rxn = 2

$$R.O.R. = K[NO_2]^2$$

or

$$-\frac{1}{2}\frac{dNO_2}{dt} = K[NO_2]^2$$

or

$$-2\frac{dO_2}{dt} = K[NO_2]^2$$

$$= +\frac{dN_2O_5}{dt} = K[NO_2]^2$$

Q $3A + B \rightarrow BA_3$

Mech: $A \rightarrow A^*$ (slow)

$A^* + 2A \rightarrow A_3$ (fast)

$A_3 + B \rightarrow BA_3$ (fast)

Select Correct Rate law expression

a) $R = K[A]$

b) $-\frac{1}{3}\frac{dA}{dt} = K[A]$

c) $-\frac{dB}{dt} = K[A]$

d) All

Sol^n = R.O.R = $K[A]^1$

$R = -\frac{1}{3}\frac{dA}{dt} = -\frac{1}{1}\frac{dB}{dt} = +\frac{1}{1}\frac{dBA_3}{dt}$

$-\frac{1}{3}\frac{dA}{dt} = K[A]$

$-\frac{dB}{dt} = K[A]$

$+\frac{dBA_3}{dt} = K[A]$

Q $N_2 + 3H_2 \rightarrow 2NH_3$

Mech

$N_2 \longrightarrow 2N^* \text{ (slow)}$

$2N^* + 3H_2 \longrightarrow 2NH_3 \text{ (Fast)}$

Select Correct statements.

a) Order of rxn = 1

b) $R = K[N_2]$

c) $+\frac{1}{2}\frac{dNH_3}{dt} = K[N_2]$

d) All Correct

Sol^n $R = K[N_2]$

$R = -\frac{dN_2}{dt} = -\frac{1}{3}\frac{dH_2}{dt} = +\frac{1}{2}\frac{dNH_3}{dt}$

Q. $2O_3 \longrightarrow 3O_2$

Mech. $O_3 \rightleftharpoons O_2 + O^*$ (fast)

✓ $O^* + O_3 \longrightarrow 2O_2$ (slow)

Write Rate law Expression

Solⁿ. $R = K[O^*][O_3]^1$

Intermediate

$K_{eq} = \frac{[O_2][O^*]}{[O_3]}$, $[O^*] = \frac{K_{eq}[O_3]}{[O_2]}$

$R = K \cdot K_{eq} \frac{[O_3]^2}{[O_2]}$

$R = K \cdot K_{eq} \cdot [O_3]^2 [O_2]^{-1}$

Order of rxn w.r.t. $O_3 = 2$

Order of rxn w.r.t $O_2 = -1$

Order of rxn $= 2 - 1 = +1$

Q3. Mechanism of a hypothetical reaction $X_2 + Y_2 \rightarrow 2XY$ is given below

[NEET 2017]

(i) $X_2 \rightleftharpoons X + X$ (fast)

(ii) $X + Y_2 \rightarrow XY + Y$ (slow)

(iii) $X + Y \rightarrow XY$ (fast)

The overall order of the reaction will be

(a) 1 (b) 2

(c) 0 (d) 1.5

$R = K[X][Y_2] = K \cdot K_{eq}^{1/2} \cdot [X_2]^{1/2}[Y_2]^1 = K \cdot K_{eq}^{1/2} \cdot [X_2]^{+1/2}[Y_2]^1$

$K_{eq} = \frac{[X][X]}{[X_2]}$

$[X]^2 = K_{eq}[X_2] \Rightarrow [X] = K_{eq}^{1/2} \times [X_2]^{1/2}$

order of rxn $= +\frac{1}{2} + 1$

$= \frac{3}{2}$

$= 1.5$


MANTHAN NEET 2025
CHEMISTRY
chemical kinetics
Lecture-10
Sarvesh Sir
Vedantu
MASTER TEACHER
SANKALP NEET
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Qsd-1 $2A_2 + B_2 \longrightarrow A_4B_2$

Mech $2A_2 \longrightarrow A_4$ (slow)

$A_4 + B_2 \longrightarrow A_4B_2$ (fast)

find out order of rxn

$R = K[A_2]^2$

a) 1

order of rxn = 2

b) 2

c) 3

d) zero

Qsd-2 $2A_2 + B_2 \longrightarrow A_4B_2$

Mech $2A_2 \rightleftharpoons A_4$ (fast) $\longrightarrow K_{eq} = \frac{[A_4]}{[A_2]^2}$, $[A_4] = K_{eq} \times [A_2]^2$

$A_4 + B_2 \longrightarrow A_4B_2$ (slow) ✓

find out order of rxn

$R = K[A_4]^1[B_2]^1$

a) 1

$R = K \cdot K_{eq} [A_2]^2 [B_2]^1$

b) 2

order of rxn = 2+1 = 3

c) 3 ✓

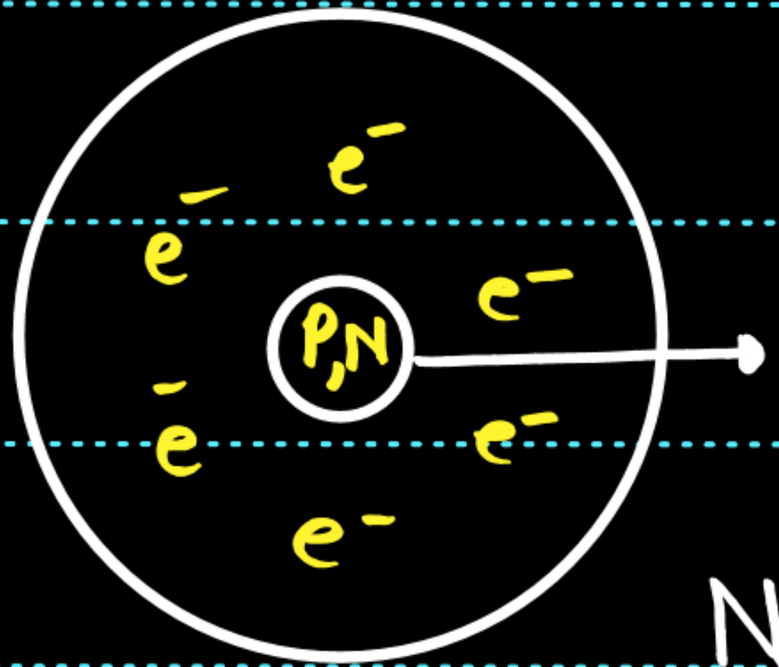
d) NONE

$\frac{?}{2}$

Nuclear Chemistry

4,5 Questⁿ → koi questⁿ nahi aya hai

Nucleon, Nucleon number & nuclide



Nucleus → Nuclide → $_{Z}X^{A}$

$A \rightarrow p+n$

$Z \rightarrow$ No. of p

Nucleon number = Sum of No. of 'p' + No. of 'n'

$$A = p + n$$

Q Calculate sum of neutron of all isotopes of H-atom.

a) 1

b) 2

~~c) 3~~

d) 4

$_Z X^A$

$n = A - Z$

H —
- $_1H^1 = H$: $1 - 1 = 0$
- $_1H^2 = D$ = $2 - 1 = 1$
- $_1H^3 = T$ = $3 - 1 = 2$

$0 + 1 + 2 = 3$

$n = A - Z$

Stability of nuclide

$\frac{N}{P} = 1 \text{ to } 1.5$ = stable nuclide , N = No. of neutron

580

P = No. of proton

$\frac{N}{P} < 1$ & $\frac{N}{P} > 1.5$ = Unstable nuclide

$n = A - Z$

Q → Select stable nuclide in given example

a) $_8O^{16}$ b) $_{90}U^{238}$ c) $_{11}Na^{23}$ d) all

$\frac{8}{8} = 1$ $\frac{238-90}{90} = \frac{148}{90} = 1.6$ $\frac{12}{11} = 1.09$

Q Select unstable nuclide $\quad \frac{N}{P} = 1 \text{ to } 1.5 \rightarrow \text{stable}$

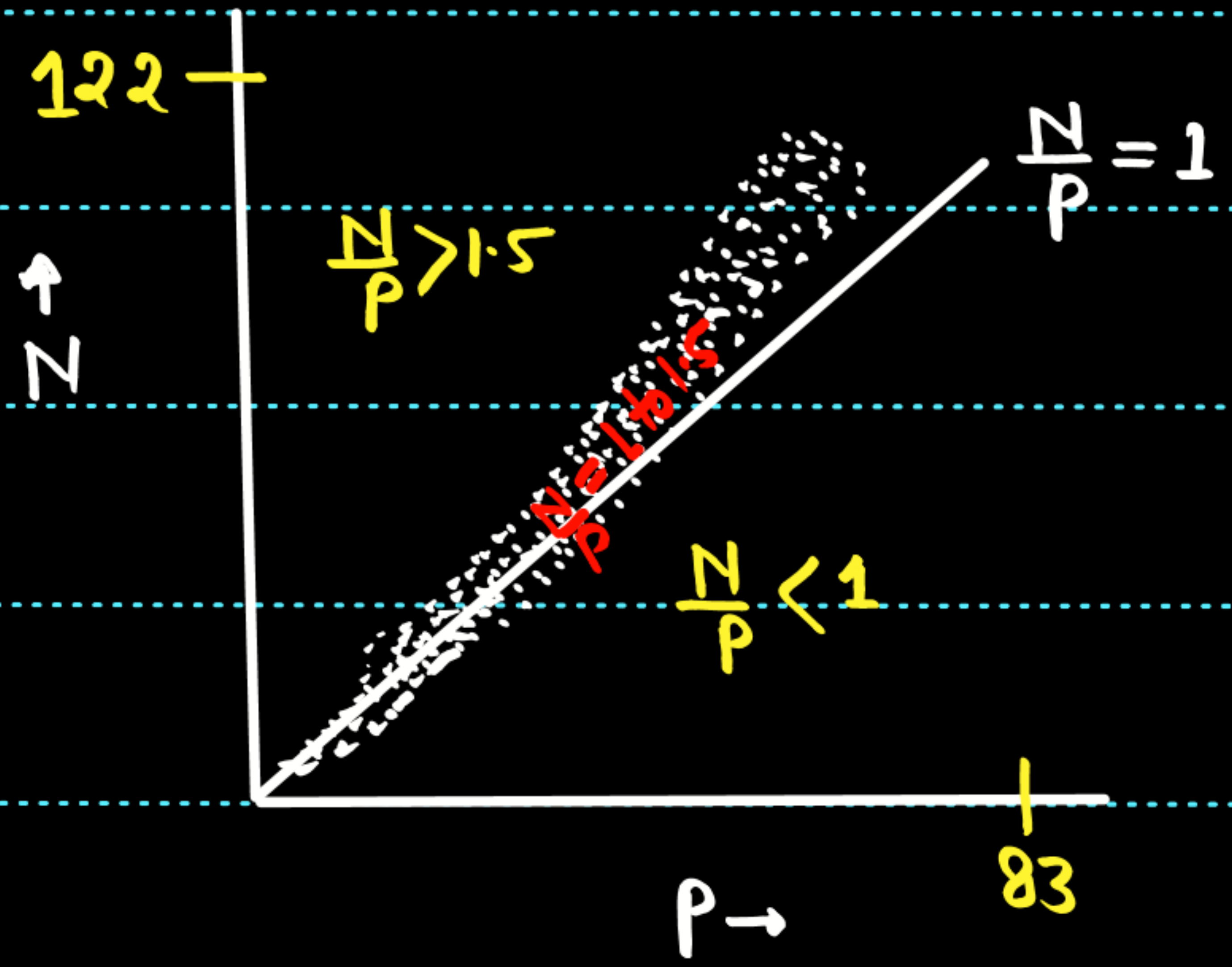
a) ${}_{82}Pb^{206} = \frac{206-82}{82} = \frac{124}{82} = 1.52$ ✓

x b) ${}_{29}Cu^{63} \rightarrow \frac{63-29}{29} = \frac{34}{29} = 1.1$

x c) ${}_{30}Zn^{65} = \frac{65-30}{30} = \frac{35}{30} = \frac{7}{6} = 1.16$

d) All

Stability graph of nuclide



* unstable nuclide ⟶ stable

Emission of particles

(α, β, positron, e-capture)

Radioactive element

α- particle

* nuclide = Very high Atomic Mass No. (A) = nucleon number

→ α- particle = (2p + 2n)

$$_{Z}X^{A} \xrightarrow{-\alpha\text{-particle}} {}_{Z-2}Y^{A-4}$$

position of element in P.T. shifted 2-point of left side of P.T.

<u>Note</u> → not applicable in f-Block

No. of α-particle = $\frac{\Delta A}{4}$ = $\frac{\text{Difference b/w Atomic Mass No.}}{4}$

Ex → $_{92}U^{234} \longrightarrow {}_{82}Pb^{206}$ $= \frac{234-206}{4} = \frac{28}{4} = 7$

Q→ Suppose element 'X' present in grp. No. = 16 in P.T. findout grp. No of New element, when 1-α-particle remove by 'X'

X → (16)

Y → (14)

a) 16

b) 14 ✓

c) 18

d) Cannot say

β-particle

* $\frac{N}{P} > 1.5$ → emission → β-particle

* (N) ⟶ (P) + β-particle $\left({}_{-1}e^{0}\right)$

* ${}_{Z}X^{A} \xrightarrow{-\beta} {}_{Z+1}X^{A}$

No. of β-particle = 2 × No. of α-particle − ΔZ

ΔZ = difference of Atomic No.

* Position of New element shifts 1-point right side of P.T.
  (f-Block ⟶ f-Block → not applicable = grp No. = 3)

Qsd X → grp. No = 13

If only 2β-particles remove in element-X

Calculate new grp. of new element

a) 13

b) 14

c) 15 ✓

d) 11

$$ {}_{Z}X \xrightarrow{-\beta} {}_{Z+1}Y \xrightarrow{-\beta} {}_{Z+2}W $$

Z → Z+2: 2 point

13 + 2 = (15)

Q

$${}_{92}U^{238} \longrightarrow {}_{82}Pb^{206}$$

(difference in mass number: 32)

No. of α, β = ?

$1\alpha \rightarrow 4$

$\rightarrow \frac{32}{4} = 8$

$${}_{92}U^{238} \xrightarrow{-8\alpha} {}_{76}Y^{206} \xrightarrow{+6,\ 6\beta} {}_{82}Pb^{206}$$

Soln → No. of α-particle $= \frac{238-206}{4} = \frac{32}{4} = 8$

No. of β-particle $= 2 \times \alpha - \Delta Z$

$= 2 \times 8 - (92 - 82)$

$= 16 - 10 = 6$

CSD

1)

$\frac{N}{P} = 1$ to $1.5 \rightarrow$ stable nuclide

$\frac{N}{P} > 1.5$ or $\frac{N}{P} < 1 \rightarrow$ unstable nuclide

2) No. of α-particle $= \frac{\Delta A}{4}$

New position in P.T. = 2 point left side Shifted in P.T.

1 α-particle = (2p + 2n)

3) No. of β-particle = 2 × No. of α-particle − ΔZ

New Position in P.T. = Shifted 1-point right side of P.T.

Note = All Radioactive decay follows 1^{st} order Kinetic

$t_{\frac{1}{2}} = \frac{0.6932}{K}$, $K = \frac{1}{t} \ln \frac{A_0}{A_t}$

Q7. The half-life of a radioactive isotope is 3h. If the initial mass of the isotope was 300 g, the mass which remained undecayed after 18 h would be

[CBSE AIPMT 2000]

(a) 4.68 g ✓

(b) 2.34 g

(c) 1.17 g

(d) 9.36 g

M-1

300 g → (3 hr) → 150 g → (3 hr) → 75 → (3 hr) → 37.5 → (3 hr) → 18.75 → (3 hr) → 9.375 → (3 hr) → 4.6825 g

M-2

$t_{\frac{1}{2}} = 3\,hr$, $t = 18h$, $A_0 = 300g$, A_t

$K = \frac{1}{t} \ln \frac{A_0}{A_t}$

$\frac{0.6932}{3} = \frac{1}{18} \ln \frac{300}{A_t}$ (18 cancelled to 6)

$0.6932 \times 6 = 2.3032 \log \frac{300}{A_t}$

$\frac{0.6932 \times 6}{2.3032} = \log \frac{300}{A_t}$

$1.8 = \log \frac{300}{A_t}$

Q9. In the following radioactive decay, ${}_{92}X^{232} \longrightarrow {}_{89}Y^{220}$, how many α and β-particles are ejected from X to Y? [CBSE AIPMT 1999]

(a) 3α and 2β

(b) 5α and 3β

(c) 3α and 3β

(d) 5α and 5β

$$\alpha = \frac{232-220}{4} = \frac{12}{4} = 3$$

$$\beta = 2 \times 3 - (92-89)$$

$$= 6-3 = 3$$

Q14. One microgram of radioactive sodium $_{11}Na^{24}$ with a half-life of 15h was injected into a living system for a bio-assay. How long will it take for the radioactivity to fall to 25% of the initial value? [CBSE AIPMT 1996]

(a) 60 h H.W

(b) 22.5 h

(c) 375 h

(d) 30 h

Q15. Half-life for radioactive ^{14}C is 5760 yr. In how many years, 200 mg of ^{14}C will be reduced to 25 mg? [CBSE AIPMT 1995]

(a) 5760 yr

(b) 11520 yr

(c) 17280 yr

(d) 23040 yr

$t_{\frac{1}{2}}$

200 → 100 → 50 → 25

5760×3

17280 yr

→ single New

→ Matching Question

→ R/A (Tsd)

→ statements

Next Class

Summary Lec

or

→ test of C.K in class

Q1. A nuclide of an alkaline earth metal undergoes radioactive decay by emission of three α-particles in succession. The group of the periodic table to which the resulting daughter element would belong is [CBSE AIPMT 2005]

(a) Group 14

(b) Group 16

(c) Group 4

(d) Group 6

2nd group $\xrightarrow[6]{-3\alpha}$

1 2 3 4 5 6 7 8 9, 10 11 12 13 14 15 16 17 18

Q3. The radio isotope, tritium ($_1H^3$) has a half-life of 12.3 yr. If the initial amount of tritium is 32 mg, how many milligrams of it would remain after 49.2 yr? [CBSE AIPMT 2003]

(a) 4 mg

(b) 8 mg

(c) 1 mg

(d) 2 mg

H.W

Q18. Emission of an alpha particle leads to a [CBSE AIPMT 1989]

(a) decrease of 2 units in the charge of the atom

(b) increase of 2 units in the mass of the atom

(c) decrease of 2 units in the mass of the atom

(d) increase of 4 units in the mass of the atom

H.W.

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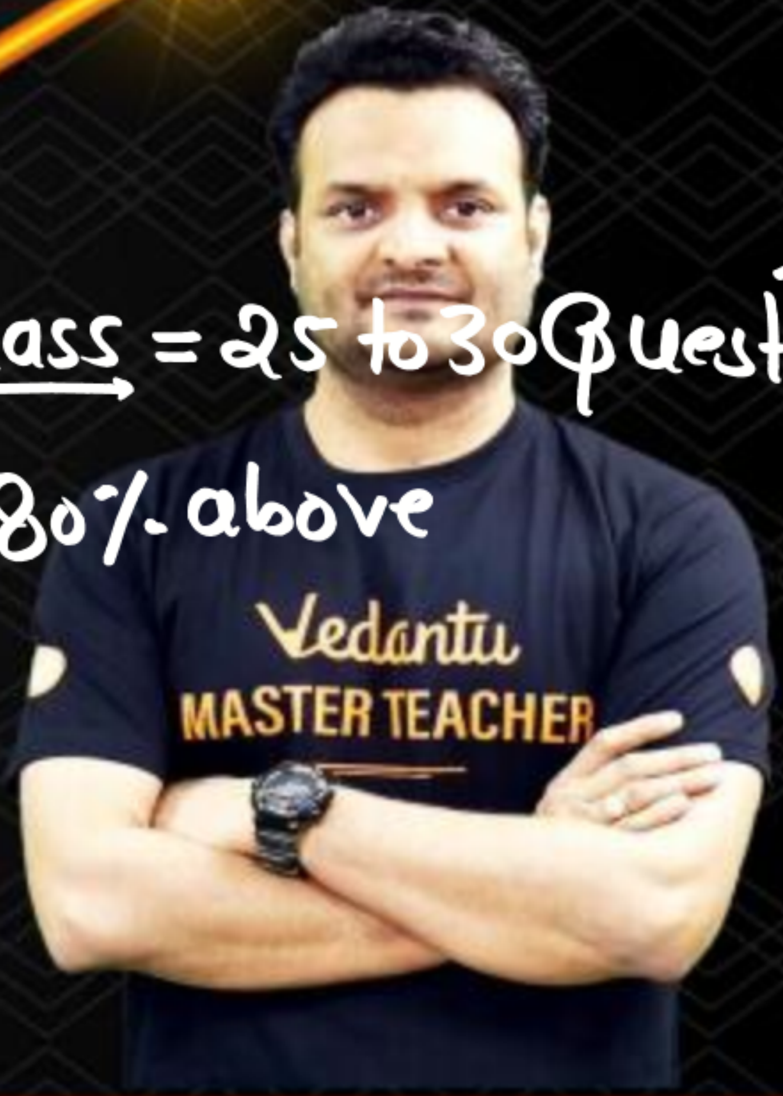
CHEMISTRY

chemical kinetics

Test class = 25 to 30 Question

Tsd → 80% above

$\frac{?}{22}$



Lecture-11

Sarvesh Sir

Ques 2: The rate of reaction is expressed as

$$+\frac{1}{2}\frac{d[C]}{dt} = -\frac{1}{3}\frac{d[D]}{dt} = \frac{1}{4}\frac{d[A]}{dt} = \frac{-d[B]}{dt}$$

The reaction is -

$3D + 1B \rightarrow 4A + 2C$

(a) $\frac{1}{4}A + \frac{1}{2}C \rightarrow B + \frac{1}{3}D$

(b) $4A + 2C \rightarrow B + 3D$

(c) $B + 3D \rightarrow 4A + 2C$

(d) $B + \frac{1}{3}D \rightarrow \frac{1}{4}A + \frac{1}{2}C$

?

Ques 3: The rate constant for the reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$ is $3 \times 10^{-5} S^{-1}$. If the rate is 2.4×10^{-5} molL^{-1} S^{-1}, then the initial concentration of N_2O_5 (in molL^{-1}) is -

(a) 1.4

(b) 1.2

(c) 0.04

(d) 0.8

$R = K[N_2O_5]^1$

$K = \left[\frac{mole}{litre}\right]^{1-n} \times Sec^{-1}$

$n = 1$

$2.4 \times 10^{-5} = 3 \times 10^{-5} [N_2O_5]$

0.8

$[N_2O_5] = 0.8$

Ques 4: The units of rate constant & rate of reaction are identical for

(a) Zero order reaction

(b) First order reaction

(c) Second order reaction

(d) Third order reaction

$$R = K[\text{Reactant}]^n$$

$$n = 0$$

$$R = K$$

?

Ques 5: The rate law for a reaction between A and B is given by rate $= K[A]^n[B]^m$. On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction become

(a) $2^{\frac{1}{(m+n)}}$

(b) $m + n$

(c) $m - n$

(d) 2^{n-m}

$R_{old} = K[A]^n[B]^m$

$R_N = K[2A]^n\left[\frac{B}{2}\right]^m$

$= K \times 2^n [A]^n \frac{1}{2^m}[B]^m$

$= K \times 2^{n-m}[A]^n[B]^m$

$R_N = 2^{n-m} \times R_{old}$

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?

Ques 8: Consider the reaction mechanism

$$A_2 \underset{}{\overset{K_2}{\rightleftharpoons}} 2A\ (fast) \rightarrow K_{eq} = K_2 = \frac{[A]^2}{[A_2]},\ [A]^2 = K_2[A_2]$$

$$A + B \xrightarrow[K_1]{} P\ (Slow)$$

(Where A is the intermediate) The rate law for the reaction is -

(a) $K_1[A][B]$

(b) $K_1K_2^{\frac{1}{2}}[A_2]^{1/2}[B]$

(c) $K_1K_2^{\frac{1}{2}}[A][B]$

(d) $K_1K_2^{\frac{1}{2}}[A]^2[B]$

$R = K_1[A][B]$

$R = K_1 K_2^{\frac{1}{2}}[A_2]^{\frac{1}{2}}[B]$

?

Ques 9: The half life of a first order reaction is 60 min. How long will it take to consume 90% of the reaction

(a) 100 min

(b) 200 min

(c) 300 min

(d) 250 min

50% rxn

$$\frac{1}{t_1}\log\frac{A_0}{A_t} = \frac{1}{t_2}\log\frac{A_0}{A_t}$$

$$\frac{1}{60}\log\frac{100}{50} = \frac{1}{t_2}\log\frac{100}{10}$$

$$\frac{1}{60}\times\log 2 = \frac{1}{t_2}\times\log 10$$

$$t_2 = \frac{60}{\log 2} = \frac{60}{0.3} = 200$$

?

Ques 10: The data for the reaction $A + B \xrightarrow{K} C$

Experiment	$[A]_0$	$[B]_0$	Initiate Rate
1	0.012	0.035	0.10
2	0.024	0.070	0.80
3	0.024	0.035	0.10
4	0.012	0.070	0.80

The rate law corresponding to the above data is

(a) $r = K[B]^3$

(b) $r = K[B]^4$

(c) $r = K[A][B]^3$

(d) $r = [A]^2[B]^2$



Ques 11: For the chemical reaction $A + 2B \rightarrow C$ the rate of reaction is increased by 2.82 times when the concentration of A is doubled and increased by 9 times when the concentration of B was tripled. What is the order with respect to B and A respectively

(a) $\frac{3}{2}, 2$

(b) $2, \frac{3}{2}$ $= 1.5$

(c) $1, \frac{3}{2}$

(d) $\frac{3}{2}, 1$

$3 \rightarrow 9 \; (3)^2$

$(B = 2)$

$R_N = 2.82\, R_{old}$

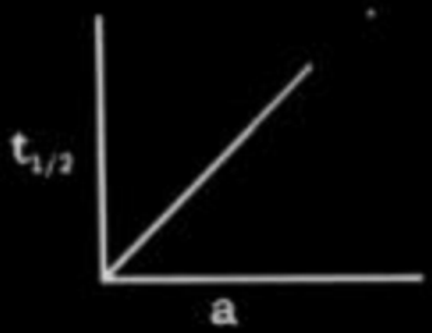
2 to 4

1 to 2

?

Ques 12: Which of the following graph is for zero order reaction

(1)



$\rightarrow t_{\frac{1}{2}} = \frac{A_0}{2K}$

(2)

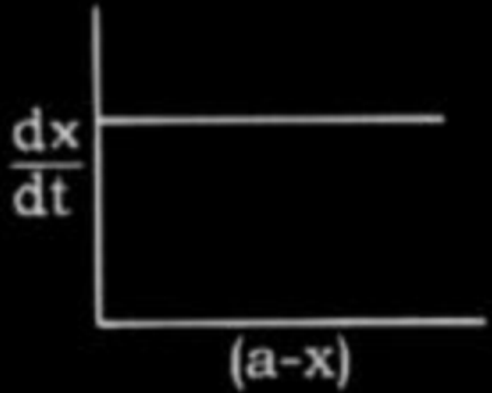


$K = \frac{x}{t}$

$x = Kt$

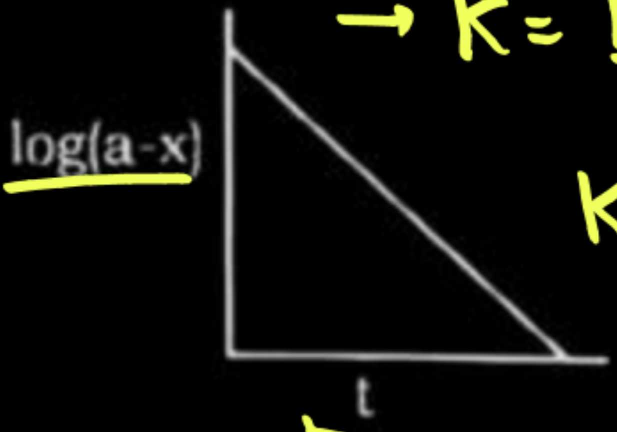
$y = mx$

(3)



$R = K$

(4)



$\rightarrow K = \frac{A_0 - A_t}{t}$

$Kt = A_0 - A_t$

$A_t = -Kt + A_0$

(a) a

(b) a, b

(c) a, b, c

(d) a, b, c, d

Ques 16: A reaction complete 10% in 5 min & 50% complete in 25 min. Which of the following is/are correct -

(A) Order of the reaction is one

(B) Order of the reaction is zero

(C) Reaction will complete in finite time

(D) Reaction will be complete the infinite time.

(a) A, B

(b) B, C

(c) A, D

(d) A, C

R = K

5 → 10%

10 → 20%

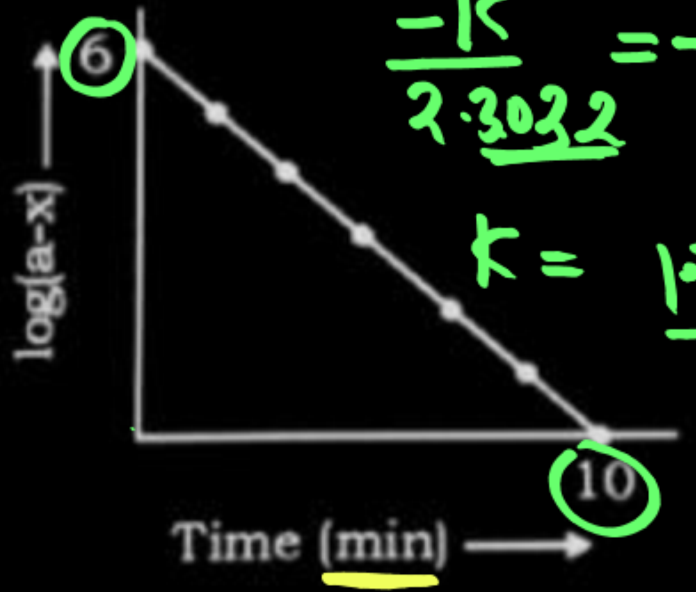
15 → 30%

20 → 40%

25 → 50%

$T_{100\%} = 2 \times t_{\frac{1}{2}}$

Ques 17: The conversion of vinyl allyl ether to pent-4-enol follows first order kinetics. The following plot is obtained for such a reaction



The rate constant for the reaction is -

(a) $4.6 \times 10^{-2} S^{-1}$

(b) $1.2 \times 10^{-2} S^{-1}$

(c) $2.3 \times 10^{-2} S^{-1}$

(d) $8.4 \times 10^{-2} S^{-1}$

Ques 18: The rate constant K_1 and K_2 of two reactions are in the ratio 2 : 1. The corresponding energies of activation of the two reactions will be related by

(assuming all other constant are same)

(a) $E_1 > E_2$

(b) $E_1 < E_2$

(c) $E_1 = 2E_2$

(d) $2E_1 = E_2$

Rxn-1 → $K_1 = A e^{-E_1/RT}$

Rxn-2 → $K_2 = A e^{-E_2/RT}$

$$\frac{K_1}{K_2} = e^{-\frac{E_1}{RT} + \frac{E_2}{RT}}$$

$$2 = e^{\frac{1}{RT}(E_2 - E_1)}$$

$$\ln 2 = \frac{1}{RT}(E_2 - E_1)$$

$$E_2 = RT \ln 2 + E_1$$

$$E_2 = 2.3032\, RT \log 2 + E_1$$

$$= 2.3032 \times 8.314 \times$$

?

Ques 21: For $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) + 22kcal$, Ea is 70 Kcal. Hence the activation energy for $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$ is:

(a) 92 Kcal ✓

(b) 70 Kcal

(c) 48 Kcal

(d) 22 Kcal

$\Delta H = -22$ Kcal

$$\Delta H = (E_a)_f - (E_a)_b$$

$$-22 = 70 - (E_a)_b$$

$$(E_a)_b = 70 + 22 = 92\ \text{Kcal}$$

Ques 47: For a first order reaction, if the time taken for completion of 50% of the reaction is t second, the time required for completion of 99.9% of the reaction is:

(a) 10t ✓

(b) 5t

(c) 100t

(d) 2t

(M-1) $t_{99.9\%} = 10 \times t_{\frac{1}{2}}$

(M-2) $= \frac{1}{t_{\frac{1}{2}}} \log \frac{100}{50} = \frac{1}{t_{99.9}} \log \frac{1000}{0.1}$

$\frac{1}{t_{\frac{1}{2}}} \times \log 2 = \frac{1}{t_{99.9}} \times \log 10^3 = \frac{3}{t_{99.9}}$

$t_{99.9} = \frac{3 \times t_{\frac{1}{2}}}{\log 2} = \frac{3 \times t_{\frac{1}{2}} \times 10}{3} = 10 t_{\frac{1}{2}}$

Ques 48: For the reaction, $2NH_3(g) \rightarrow N_2(g) + 3H_2(g) - \frac{d[NH_3]}{dt} = k_1[NH_3]; \frac{d[N_2]}{dt} = k_2[NH_3]; \frac{d[H_2]}{dt} = k_3[NH_3]$ the relation between k_1, k_2 and k_3 may be given as:

(a) $1.5\,k_1 = 3k_2 = k_3$

(b) $2k_1 = k_2 = 3k_3$

(c) $k_1 = k_2 = k_3$

(d) $k_1 = 3k_2 = 2k_3$

$R.O.R = \frac{r_{NH_3}}{2} = \frac{r_{N_2}}{1} = \frac{r_{H_2}}{3}$

$R = \frac{k_1}{2} = \frac{k_2}{1} = \frac{k_3}{3}$

$\frac{3k_1 = 6k_2 = 2k_3}{6} \rightarrow 1.5k_1 = 3k_2 = k_3$



Ques 51: A reaction takes place in three steps with activation energy

$E_{a_1} = \frac{180kJ}{mol}, E_{a_2} = 80kJ/mol$ and

$E_{a_3} = 50kJ/mol$ respectively.

Overall rate constant of the reaction is

$k = \left[\frac{k_1 k_2}{k_3}\right]^{2/3} = k_1^{2/3} \cdot k_2^{2/3} \cdot k_3^{-2/3}$

$K = K_1^{x} K_2^{y} K_3^{z} \ldots$

$E = x_1 E_1 + y E_2 + z E_3 \ldots$

The activation energy of the reaction will be:

(a) 140 kJ/mol

(b) 150 kJ/mol

(c) 43.44 kJ/mol

(d) 100 kJ/mol

$E = \frac{2}{3} \times E_1 + \frac{2}{3} \times E_2 - \frac{2}{3} \times E_3$

$= \frac{2}{3} \times 180 + \frac{2}{3} \times 80 - \frac{2}{3} \times 50$

$= \frac{360}{3} + \frac{160}{3} - \frac{100}{3} = \frac{420}{3} K$

140

?

Ques 54: A chemical reaction proceeds into the following steps

Step I: $2A \rightleftharpoons X$ (fast)

Step II: $X + B \rightarrow Y$ (slow)

Step III: $Y + B \rightarrow$ Product (fast)

The rate law for the overall reaction is:

(a) Rate = $k[A]^2$

(b) Rate = $k[B]^2$

(c) Rate = $k[A][B]$

(d) Rate = $k[A]^2[B]$

$K_{eq} = \frac{[X]}{[A]^2}$

$R = k[X][B]$

$= k \cdot K_{eq}[A]^2[B]$

K

?

Ques 66: For the reaction $2A \rightarrow P$, the rate constant and initial concentration of A are y mole L^{-1} sec^{-1} and x mole L^{-1} respectively. The half life period of reaction is-

(a) $\frac{x}{2y}$

(b) $\frac{x}{4y}$

(c) $\frac{1}{xy}$

(d) None

$K = \left[\frac{\text{Mole}}{\text{Litre}}\right]^{1-n} \text{sec}^{-1}$

$n = 0$

mole × litre^{-1} × sec^{-1}

$t_{\frac{1}{2}} = \frac{A_0}{2K} = \frac{x}{2y} = \frac{x}{2y}$

?

Ques 70: ${}^{235}_{92}U$ belongs to III[redacted] group of the periodic table. It loses one α-particle, the new element will belong to the group

(a) II

(b) I

(c) III

(d) V

$${}_{92}U^{235} \xrightarrow[({}_{2}He^{4})]{\alpha} {}_{90}X^{231}$$

F-Block F-Block



Ques 75: For a particular reaction with initial conc. Of the reactants as a_1 & a_2, the half-life period are t_1 & t_2 respectively. The order of the reaction (n) is given by

(a) $n = 1 + \dfrac{\log\left(\frac{t_2}{t_1}\right)}{\log\left(\frac{a_2}{a_1}\right)}$

(b) $n = \dfrac{\log\left(\frac{t_1}{t_2}\right)}{\log\left(\frac{a_2}{a_1}\right)}$

(c) $n = 1 + \dfrac{\log\left(\frac{t_1}{t_2}\right)}{\log\left(\frac{a_2}{a_1}\right)}$

(d) None of these

?

$n = 1 + \dfrac{\log t_1/t_2}{\log (a_1/a_2)^{-1}}$

$t_{\frac{1}{2}} \propto (A_0)^{1-n}$

$t_1 \propto (a_1)^{1-n}$

$t_2 \propto (a_2)^{1-n}$

$\dfrac{t_1}{t_2} = \dfrac{(a_1)^{1-n}}{(a_2)^{1-n}} = \left(\dfrac{a_1}{a_2}\right)^{1-n}$

$\log \dfrac{t_1}{t_2} = \log\left(\dfrac{a_1}{a_2}\right)^{1-n}$

$\log \dfrac{t_1}{t_2} = (1-n)\log \dfrac{a_1}{a_2}$

$1-n = \dfrac{\log t_1/t_2}{\log a_1/a_2}$

$n = 1 - \dfrac{\log t_1/t_2}{\log a_1/a_2}$

Ques 81: In a zero order reaction :

R = K

(a) The rate is independent of the concentration of the reactants

(b) The half life depends on the concentration on the reactants → $t_{\frac{1}{2}} = \frac{A_0}{2K}$

(c) The rate constant has the unit mol $litre^{-1}$ s^{-1} → K = R = mole $litre^{-1}$ sec^{-1}

(d) All of these

?

Ques 83: For a reaction A → B; if

log K(sec-1) = 14 - $\frac{1.25 \times 10^4}{T}$, The Arrhenius parameter (A) and energy of activation (E_a) for the reaction are:

(a) $10^{14} Sec^{-1}$, 239.34 kJ

(b) $14\ sec^{-1}$, 57.6 kcal

(c) $10^{14} sec^{-1}$, 23.93 kj

(d) 10^{14} sec, 5.76 kcal

$\log K = \frac{-E_a}{2.303\,2R}\left(\frac{1}{T}\right) + \log A_0$

$\log A_0 = 14$

$A_0 = 10^{14}$

$\frac{E_a}{2.303\,2R} = 1.25 \times 10^4$

$E_a = 1.25 \times 10^4 \times 2.303\,2R = 23.936 \times 10^4$ Joule

$= 239.36$ KJ

?

$10^{1.4}$

Ques 94: In the presence of catalyst, E_a is lowered by 2 Kcal at 27°C, hance rate will increase by-

(a) 20 times

(b) 14 times ✓

(c) 28 times

(d) 2 times

$$K_a = A e^{-E_a/RT}$$

$$K_p = A e^{-E_p/RT}$$

$$\frac{K_a}{K_p} = e^{\frac{E_p}{RT} - \frac{E_a}{RT}}$$

$$\frac{K_a}{K_p} = e^{-\frac{1}{RT}(E_a - E_p)}$$

$$\log\left(\frac{K_a}{K_p}\right)^{-1} = 28.3$$

$$\log\frac{K_p}{K_a} = 28.3$$

$$\frac{K_p}{K_a} = 10^{28.2}$$

$$K_p = K_a \times 10^{28.2}$$

$$\frac{K_a}{K_p} = e^{-\frac{1}{RT}\times 2}$$

$$\ln\frac{K_a}{K_p} = -\frac{2}{RT} = -\frac{2}{0.0821\times 300}$$

$$\ln\frac{K_a}{K_p} = -\frac{2\times 10^3\,\text{cal}}{2\times 300} = -\frac{10}{3}$$

$$\log\frac{K_p}{K_a} = \frac{10}{3\times 2.303\,2} = \frac{10}{7}$$

K_p

Ques 86: Two first order reaction have half-lives in the ratio 8 : 1. Calculated the ratio of times intervals $t_1 : t_2$. The time t_1 and t_2 are the times period for 25% and 75% completion.

(a) 1 : 0.301

(b) 0.125 : 0.602

(c) 1 : 602

(d) 1 : 0.602

?

Ques 92: For the reaction $A_g \rightarrow B_g + C_g$ rate law is $-\frac{d[A]}{dt} = k[A]$. At the start pressure is 100 mm and after 10 min pressure is 120mm. Hence the rate constant is (in min^{-1}):

(a) $\frac{2.303}{10}\log_{10}\frac{6}{5}$

(b) $\frac{2.303}{10}\log_{10}5$

(c) $\frac{2.303}{10}\log_{4}\frac{5}{4}$

(d) $\frac{2.303}{10}\log_{10}\frac{5}{6}$

?

Ques 93: $A \rightarrow B, K_1 = 10^{15}e^{-2000/RT}$

$C \rightarrow D, K_2 = 10^{14}e^{-1000/RT}$

Temperature T at which $K_1 = K_2$ is-

(a) 1000 K

(b) 2000 K

(c) $\frac{2000}{2.303R}$K

(d) $\frac{1000}{2.303R}K$

?

Ques 98: What is the energy of activation of a reaction if its rate doubles when the temperature is raised from 290 K to 300 K

(a) 12 kcal

(b) 18 kcal

(c) 28 kcal

(d) 45 kcal

?

Ques 117: For a given reaction $\mathbf{A} \rightarrow$ product, rate is $1 \times 10^{-4}\mathrm{M}\, S^{-1}$ when [A] = 0.01 M and rate is $1.41 \times 10^{-4}\mathrm{M}\, s^{-1}$ when [A] 0.02M. Hence rate law is:

(a) $-\frac{\mathrm{d[A]}}{\mathrm{dt}} = \mathrm{k[A]}^2$

(b) $-\frac{\mathrm{d[A]}}{\mathrm{dt}} = \mathrm{k[A]}$

(c) $-\frac{\mathrm{d[A]}}{\mathrm{dt}} = \frac{\mathrm{K}}{4}\mathrm{[A]}$

(d) $-\frac{\mathrm{d[A]}}{\mathrm{dt}} = \mathrm{k[A]}^{1/2}$

?

Ques 125: Correct relation for first order reaction is:

(A) $T_{75} = 3 \times T_{50}$

(B) $T_{87.5} = 3 \times T_{50}$

(C) $T_{99.9} = 10 \times T_{50}$

(D) $T_{av} = \frac{T_{50}}{1.44}$

(a) A, B, C, D

(b) B, C

(c) A, C

(d) A, B , D

?

THANK YOU
All the Best!! 👍

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MANTHAN NEET 2025

CHEMISTRY

chemical kinetics

Test syllabus → Chemical Kinetics

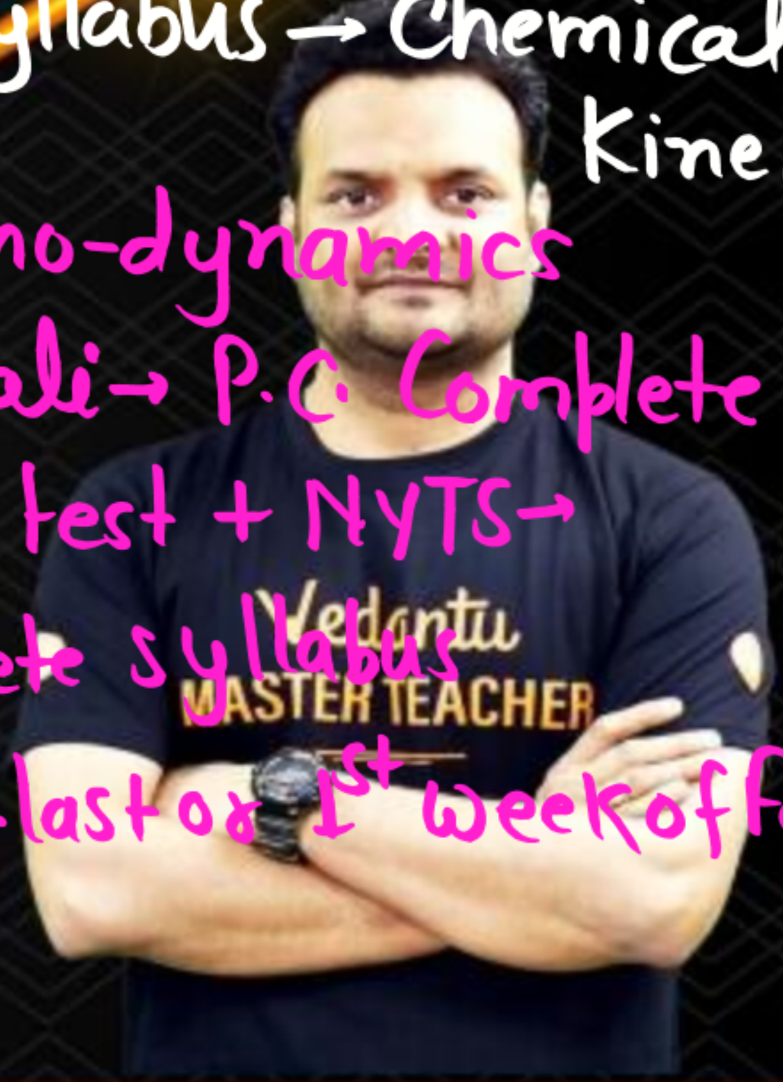
→ thermo-dynamics

→ Dewali → P.C. Complete

→ Class test + NYTS →

→ Complete syllabus

→ Jan-last or 1st week of Feb



Lecture-12

Sarvesh Sir

Ques 47: For a first order reaction, if the time taken for completion of 50% of the reaction is t second, the time required for completion of 99.9% of the reaction is:

(a) 10t

(b) 5t

(c) 100t

(d) 2t

$t_{99.9\%} = 10 \times t_{1/2} = 10 \times t = 10t$ sec

Qsd-2

Ques 86: Two first order reaction have half-lives in the ratio 8 : 1. Calculated the ratio of times intervals $t_1 : t_2$. The time t_1 and t_2 are the times period for 25% and 75% completion.

$\frac{8}{5}$

(a) 1 : 0.301

(b) 0.125 : 0.602

(c) 1 : 602

(d) 1 : 0.602

R-1 → $(t_{1/2})_1$ → $t_1 = 25\%$

R-2 → $(t_{1/2})_2$ → $t_2 = 75\%$ → $t_2 = 2 \times (t_{1/2})_2$

$$\frac{(t_{1/2})_1}{(t_{1/2})_2} = \frac{8}{1}$$

$$\frac{1}{(t_{1/2})_1} \log \frac{100}{50} = \frac{1}{t_1} \log \frac{100}{75}$$

$$\frac{1}{(t_{1/2})_1} \log 2 = \frac{1}{t_1} \log \frac{4}{3} = \frac{1}{t_1} (\log 4 - \log 3)$$

$$= \frac{1}{t_1}(0.6 - 0.48) = \frac{1}{t_1} \times 0.12$$

$$\frac{1}{(t_{1/2})_1} \times \frac{0.2}{10} = \frac{1}{t_1} \times \frac{0.12}{100}$$

$$t_1 = \frac{2 \times (t_{1/2})_1}{5}$$

$$\frac{t_1}{t_2} = \frac{2 \times (t_{1/2})_1 / 5}{2 \times (t_{1/2})_2} = \frac{(t_{1/2})_1}{(t_{1/2})_2 \times 5} = \left(\frac{8}{1}\right) \times \frac{1}{5} = \frac{8/8}{5/8} = \frac{1}{0.625}$$

Qsd-3

Ques 92: For the reaction $A_g \rightarrow B_g + C_g$ rate law is $-\frac{d[A]}{dt} = k[A]$. At the start pressure is 100 mm and after 10 min pressure is 120mm. Hence the rate constant is (in min^{-1}):

(a) $\frac{2.303}{10}\log_{10}\frac{6}{5}$

(b) $\frac{2.303}{10}\log_{10}5$

(c) $\frac{2.303}{10}\log_{4}\frac{5}{4}$ ✓

(d) $\frac{2.303}{10}\log_{10}\frac{5}{6}$

$$A \rightarrow B + C$$

$t=0$: $100 \quad 0 \quad 0$

$10\,min$: $P_t = (100-P) \quad P \quad P$

$P_T = P_A + P_B + P_C$

$120 = 100 - P + P + P$

$P = 120 - 100 = 20\,mm$

$K = \frac{2.303}{t}\log\frac{P_0}{P_t}$

$= \frac{2.303}{10}\log\frac{100}{80}$

$= \frac{2.303}{10}\log\frac{5}{4}$


?
3

Reaction

Fast rxn	Very slow rxn	Moderate rxn or slow rxn
x	x	measure rate of moderate rxn

Rate → Change in Con. per unit time

$$\text{Rate} = \frac{C_f - C_i}{t_f - t_i} = \frac{\Delta C}{\Delta t}$$

Type of Rate

1) Instantaneous Rate – Rate measure in very very small interval of time ⇒ Rate $= \frac{dc}{dt}$ = slope of Curve

2) Average Rate = Rate measure in large interval of time

$$(\text{Rate})_{avg} = \frac{\Delta C}{\Delta t} = \frac{C_f - C_i}{t_f - t_i}$$

Unit of Rate = $\frac{\text{mole}}{\text{sec}}$/litre or mole·litre^{-1} sec^{-1}

Rate of reaction

$$n_1 A + n_2 B \longrightarrow n_3 C$$

$r_A = -\frac{dA}{dt}$ = Rate of disappearance of A

$r_B = -\frac{dB}{dt}$ = " " " " B

$r_C = +\frac{dC}{dt}$ = Rate of formation of C

$$\text{Rate of Reaction} = \frac{-r_A}{n_1} = \frac{-r_B}{n_2} = \frac{+r_C}{n_3}$$

Type of Rxn in basis of No. of step used in mechanism

a) Elementry Reaction = Rxn complete in single step

Ex → S_N2, E_2

b) Complex Reaction = Rxn complete more than one step

Ex → S_N1, E_1

Molecularity total No. of species

Colloids simultaneously in elementary reaction and form product

M = 1, 2, 3,

M ≠ 0 , M ≠ fractional

M ≠ negative

Max. molecularity = 3

Min " " = 1

Order of Reaction

$n_1 A + n_2 B \longrightarrow n_3 C$

$Rate = K [A_t]^x [B_t]^y$ → Exp. Eq.

$n_1 = x$, $n_1 \neq x$

$n_2 = y$, $n_2 \neq y$

→ total sum of power of Reactant Con. in Rate law expression Eq.

$= x + y$

→ theoretical quantity

→ only applicable in elementry rxn

Note → For elementry rxn

Molecularity = order of rxn

= sum of stoichiometry ceofficient

of Reactant in elementry rxn

→ O·R = 0, 1, 2, 3, fractional negative

→ Experimental quantity

→ Max. O·R = 3

→ Elementry and Complex rxn = both applicable

Zero order of Rxn

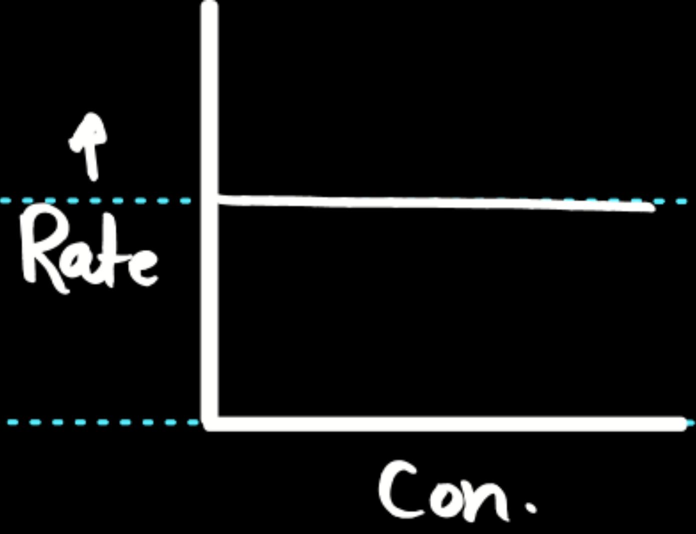
$R = K[A_t]^0 \Rightarrow \boxed{R = K}$

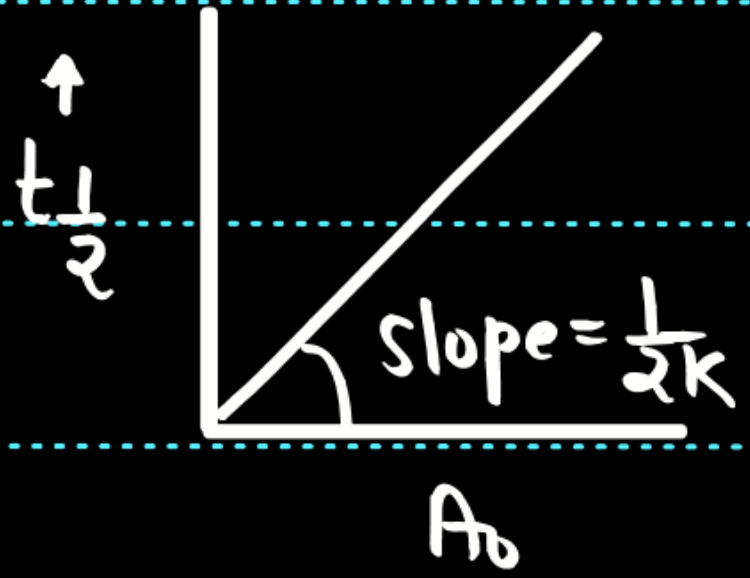
→ not depend upon Con. of Reactant

→ $K = \dfrac{A_0 - A_t}{t} = \dfrac{x}{t}$

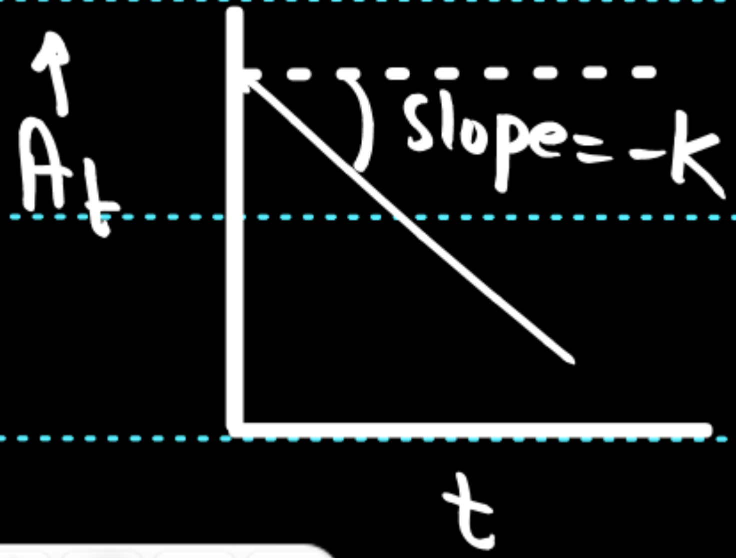
→ $t_{\frac{1}{2}} = \dfrac{A_0}{2K}$ → $t_{\frac{1}{2}} = \dfrac{1}{2K} \times A_0$

→ $t_{100\%} = 2 \times t_{\frac{1}{2}} = 2 \times t_{50\%}$





$Kt = A_0 - A_t$



$A_t = -Kt + A_0$

$y = -mx + C$

1^{st} order Rxn

$$A \longrightarrow B$$

$A_0 \quad\quad 0 \quad\quad t=0$

$A_t = (A_0 - x) \quad\quad x \quad\quad t\,sec$

$$R = K[A_t]^1 \longrightarrow R \propto [A_t]$$

Rate of 1^{st} rxn = variable

$$K = \frac{1}{t}\ln\frac{A_0}{A_t} = \frac{2.3032}{t}\log\frac{A_0}{A_t}$$

$$t_{\frac{1}{2}} = \frac{\ln 2}{K} = \frac{2.3032}{K}\log 2 = \frac{0.6932}{K}$$

1^{st} order, $t_{\frac{1}{2}} \rightarrow$ fixed value, not depend upon Con. of Reactant

- $\rightarrow t_{75\%} = 2 \times t_{50\%}$
- $\rightarrow t_{87.5\%} = 3 \times t_{50\%}$
- $\rightarrow t_{99.9\%} = 10 \times t_{50\%}$

→ x% Rxn Complete in t_1 Sec.

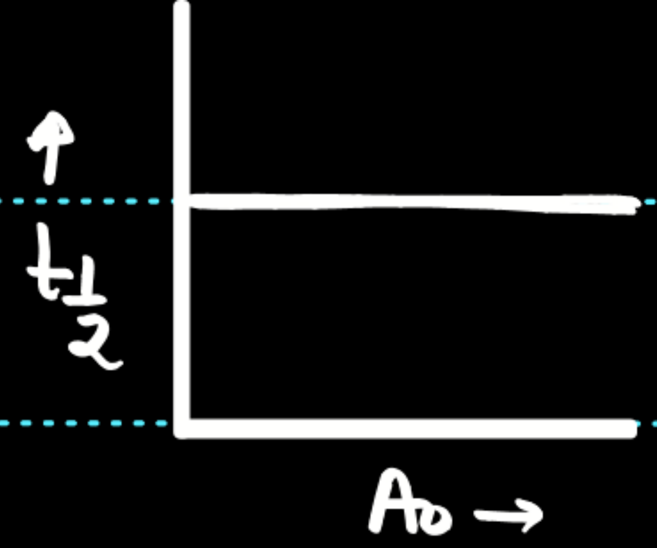
y% Rxn Complete in t_2 Sec

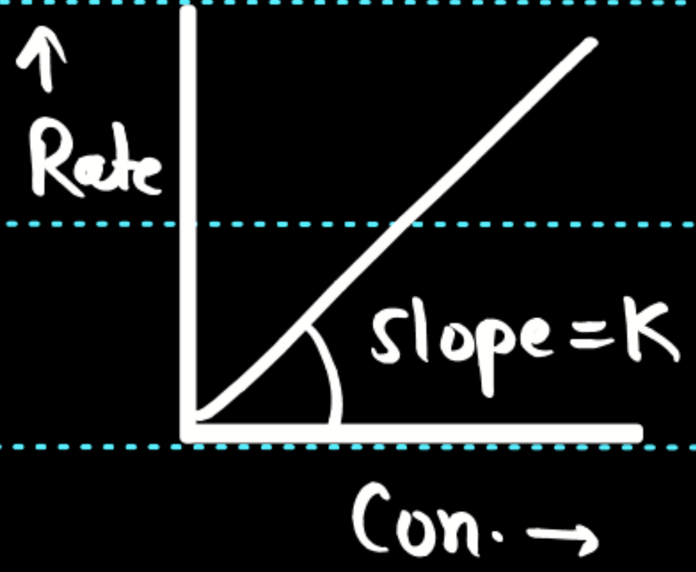
$$\frac{1}{t_1}\log\frac{100}{100-x} = \frac{1}{t}\log\frac{100}{100-y}$$

→ x part Rxn complete t_1 sec

y part Rxn complete in t_2 Sec

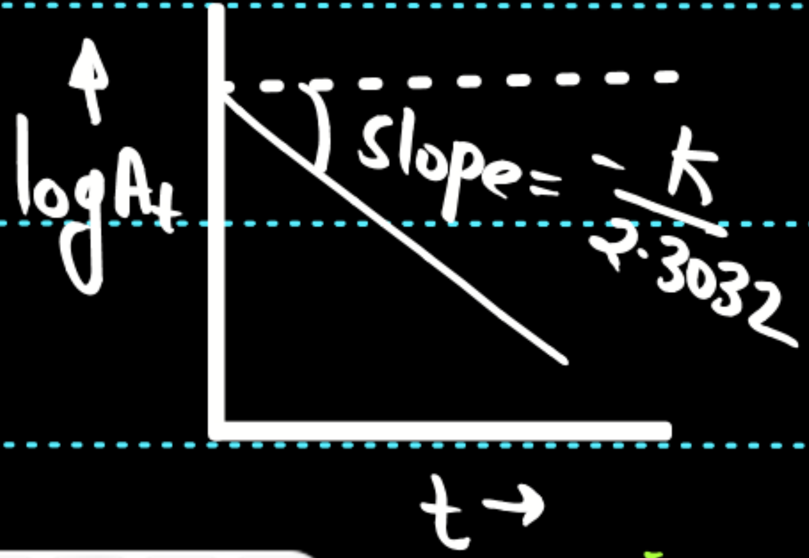
$$\frac{1}{t_1}\log\frac{1}{1-x} = \frac{1}{t_2}\log\frac{1}{1-y}$$





$$K = \frac{2.3032}{t}\log\frac{A_0}{A_t}$$

$$\frac{Kt}{2.3032} = \log A_0 - \log A_t$$



$$\log A_t = -\frac{K}{2.3032} \times t + \log A_0$$

$$y = -m\,x + c$$

n^{th} order of rxn

$$A \rightarrow B$$

$$R = K[A_t]^n$$

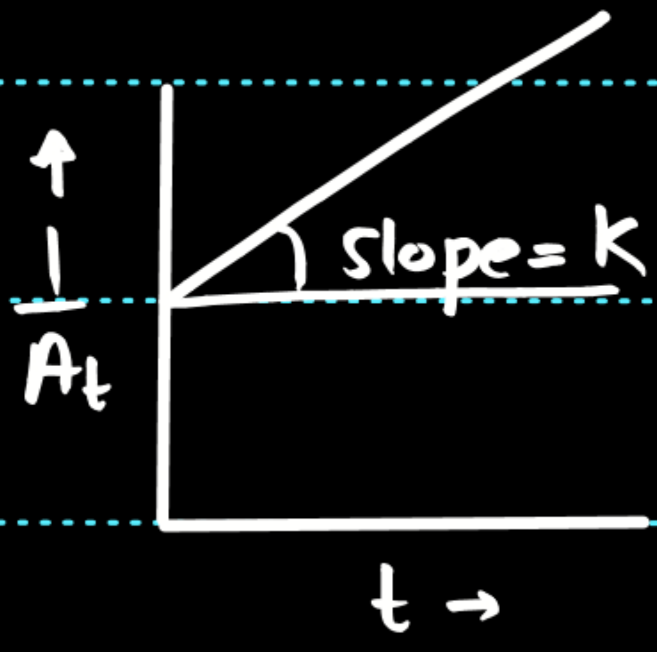
$$K = \frac{1}{(n-1)t}\left[\frac{1}{(A_t)^{n-1}} - \frac{1}{(A_0)^{n-1}}\right]$$

$n = 2 \rightarrow$ Second order

$$K = \frac{1}{t}\left[\frac{1}{A_t} - \frac{1}{A_0}\right]$$

$$t_{\frac{1}{2}} = \frac{1}{K \times A_0}$$

$$t_{\frac{1}{2}} \propto (A_0)^{1-n}$$



$$Kt = \frac{1}{A_t} - \frac{1}{A_0}$$

$$\frac{1}{A_t} = K(t) + \frac{1}{A_0}$$

$$y = mx + C$$

Effect of temp. in Rate of rxn

Rate of Rxn ∝ temperature

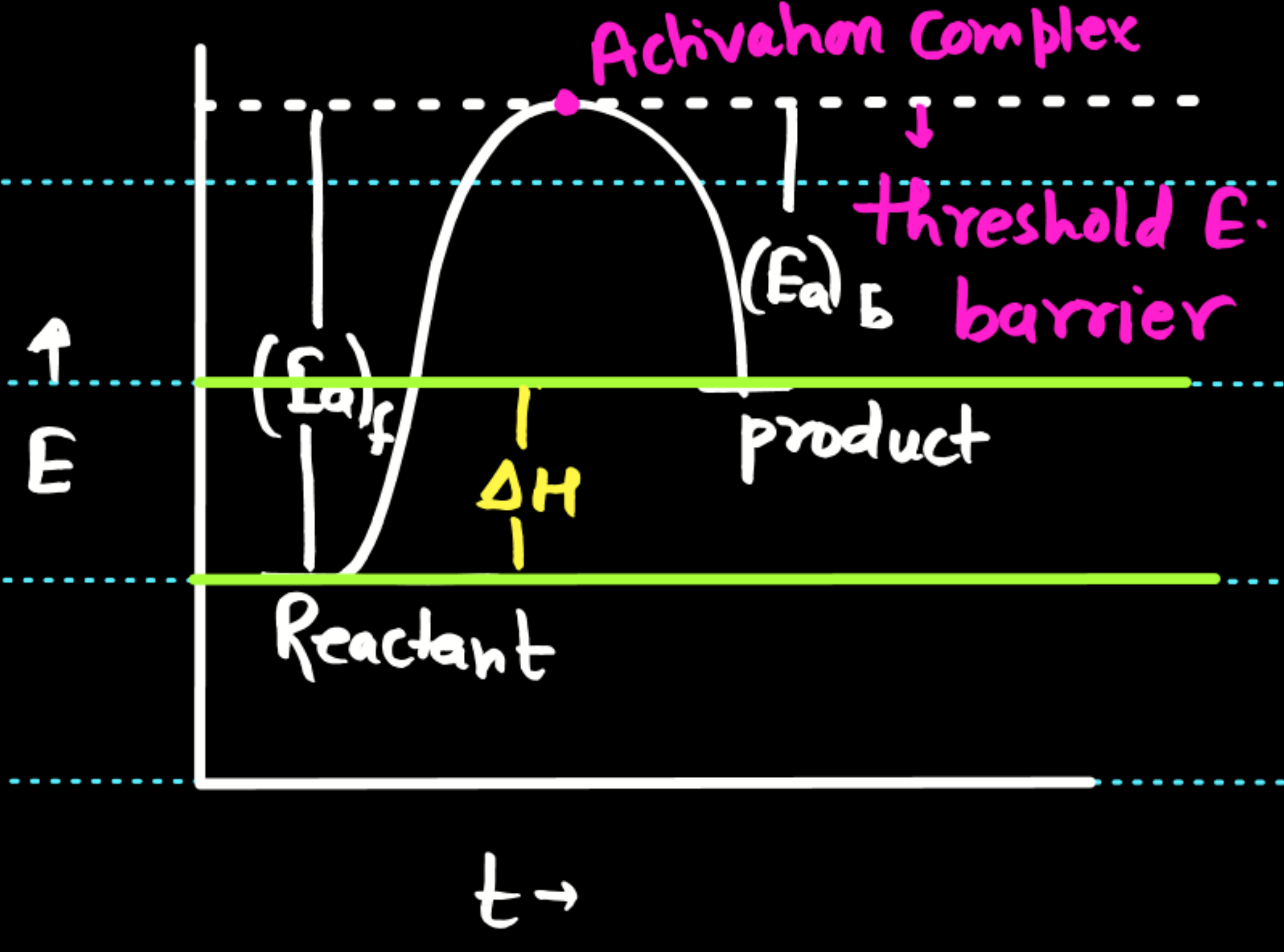
$$K = A e^{-E_a/RT}$$

Where → K = Rate Const

A = Arrhinus parameter

E_a = Activation Energy

T = temperature



→ E_a → min. Energy required to reach Activatⁿ complex and Convert into prd.

→ $E_a \neq 0$, $E_a \neq$ negative.

→ E_a depend upon temp. theoretically

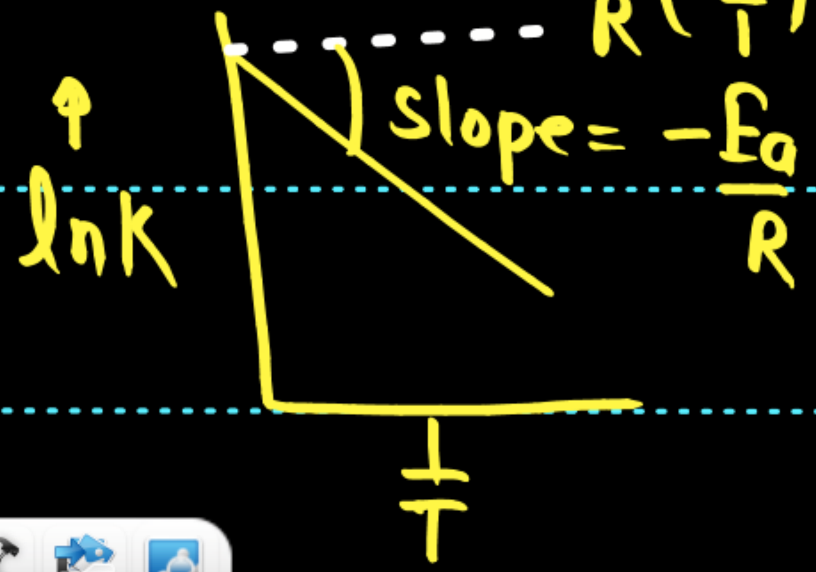
→ Catalyst decrease E_a

→ $\Delta H = (E_a)_f - (E_a)_b$

→ ΔH does not in presence Catalyst

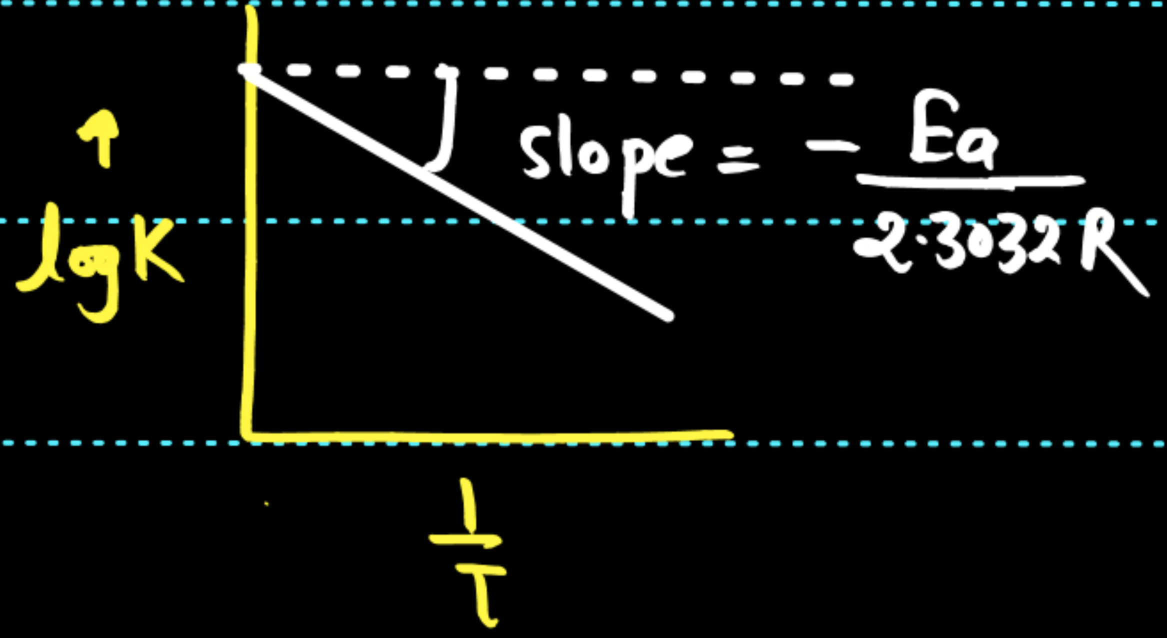
→ $K = A e^{-E_a/RT}$

→ $\ln K = -\frac{E_a}{R}\left(\frac{1}{T}\right) + \ln A$



$\log K = \frac{-E_a}{2.3032R}\left(\frac{1}{T}\right) + \log A$

$y = -m \quad x + c$



$$\log \frac{K_2}{K_1} = \frac{E_a}{2.3032R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

Where → $T_1 K$ → Rate Const (K_1)

$T_2 K$ → K_2

$$\log\frac{R_2}{R_1} = \frac{E_a}{2.3032R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

Arrhinus Eq. applicable for zero order rxn

$R = K$

$T_1 K \rightarrow K_1 \rightarrow R_1$

$T_2 K \rightarrow K_2 \rightarrow R_2$

$$\frac{R_2}{R_1} = \frac{K_2}{K_1}$$

temperature Coefficient

$$\mu_T = \frac{K_{T+10}}{K_T}$$

$$\mu_T = \frac{A e^{-E_a/R(T+10)}}{A e^{-E_a/RT}}$$

$$\mu_T = e^{+\frac{E_a}{R}\left(\frac{1}{T} - \frac{1}{T+10}\right)}$$

in general Rate increases 2 time in rise in temp 10°C

Collision theory

→ Rxn occurs in collision b/w molecules

a) Orientation factor

b) Energy factor

$e^{-E_a/RT}$ = fraction of molecules of Reactant which have Kinetic Energy greater than its Activation Energy

Rate of rxn = Collision factor × Energy factor

$$K = P \times Z \times e^{-E_a/RT}$$

Where ⇒ Z = total No. of effective collision

P = probability of effective collision which is convert to product

Nuclear chemistry

$\frac{N}{P} = 1$ to $1.5 \rightarrow$ nuclide = stable

$\frac{N}{P} < 1$, $\frac{N}{P} > 1.5 \rightarrow$ nuclide = unstable

all Radioactive Rxn follows 1^{st} order Kinetics

$$K = \frac{1}{t} \ln \frac{A_0}{A_t}$$

$$t_{\frac{1}{2}} = \frac{0.6932}{K}$$

$$\text{No. of } \alpha\text{-particle} = \frac{\Delta A}{4} = \frac{\text{difference of Mass No.}}{4}$$

$$T_{avg} = 1.44 \times t_{\frac{1}{2}}$$

No. of β-particle = $2 \times$ No. of $\alpha - \Delta Z$ (difference in Atomic No.)

Ques 79: For the reaction, $N_2O_5 \rightarrow 2NO_2 + 1/2\ O_2$; Given $-\frac{d[N_2O_5]}{dt} = K_1[N_2O_5]$ and $\frac{d[O_2]}{dt} = K_3[N_2O_5]$

The relation in between K_1, K_2 and K_3 is :

(a) $2K_1 = K_2 = 4K_3$

(b) $K_1 = K_2 = 4K_3$

(c) $2K_1 = 4K_2 = K_3$

(d) None of these

Ques 80: A reaction takes place in three steps having rate constants K_1, K_2 and K_3 respectively. The overall rate constant $K = \frac{K_1 K_3}{K_2}$. If energy of activation for the three steps are respectively 50, 20 and 40 kJ. The overall energy of activation is :

(a) 30 kJ

(b) 20 kJ

(c) 10 kJ

(d) 70 kJ

Ques 93: $A \rightarrow B, K_1 = 10^{15} e^{-2000/RT}$

$C \rightarrow D, K_2 = 10^{14} e^{-1000/RT}$

Temperature T at which $K_1 = K_2$ is-

(a) 1000 K

(b) 2000 K

(c) $\frac{2000}{2.303R}$ K

(d) $\frac{1000}{2.303R} K$

Ques 98: What is the energy of activation of a reaction if its rate doubles when the temperature is raised from 290 K to 300 K

(a) 12 kcal

(b) 18 kcal

(c) 28 kcal

(d) 45 kcal

Ques 117: For a given reaction $\mathbf{A} \rightarrow$ product, rate is $1 \times 10^{-4} \mathrm{M}\, S^{-1}$ when [A] = 0.01 M and rate is $1.41 \times 10^{-4} \mathrm{M}\, s^{-1}$ when [A] 0.02M. Hence rate law is:

(a) $-\frac{d[A]}{dt} = k[A]^2$

(b) $-\frac{d[A]}{dt} = k[A]$

(c) $-\frac{d[A]}{dt} = \frac{K}{4}[A]$

(d) $-\frac{d[A]}{dt} = k[A]^{1/2}$

Ques 125: Correct relation for first order reaction is:

(A) $T_{75} = 3 \times T_{50}$

(B) $T_{87.5} = 3 \times T_{50}$

(C) $T_{99.9} = 10 \times T_{50}$

(D) $T_{av} = \frac{T_{50}}{1.44}$

(a) A, B, C, D

(b) B, C

(c) A, C

(d) A, B , D

THANK YOU
All the Best!!

SANKALP NEET VEDANTU

MANTHAN NEET 2025

CHEMISTRY

thermodynamics

Lecture-01

Sarvesh dixt· Csd official

→ Notebook → perday Revision



Sarvesh Sir

Today's Goal -

terminology

SYSTEM, SURROUNDING AND BOUNDARY

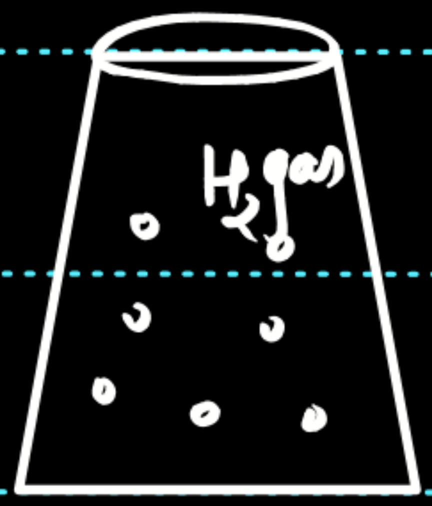
Any specified portion of universe under investigation is called system and the rest of the universe is called surroundings

Boundary = the real or imaginary surface that separates the system from its surroundings is called boundary.

Universe = system + Surrounding

sys ⇌ Surr^n

Ex →



Volume of H_2 gas is 10L.

findout system

a) H_2 gas ✓

b) Container

c) $H_2(g)$ + Container

d) NONE

Q-2 select boundary of given example

a) $H_2(g)$ b) ✓ wall of Container

c) both d) NONE

Boundary

Conductor

→ Heat transfer between sys and surr^n

→ sys ⇌ surr^n

Insulater

Heat or energy does not transfer between sys and surr^n

Q 1 litre water present in iron container.

If temp. of water is 90°C. select correct statements

a) water → sys ✓

b) iron wall → boundary ✓

c) Iron wall → Conductor boundary ✓

d) All Correct ✓

TYPE OF SYSTEM

1. **Open system** An open system is defined as in which the mass and energy can be transfer to its surrounding."

2. **Close system** A closed system is defined as in which the mass is fixed (No mass can cross the boundary of the system) and energy can be transfer to its surrounding.

Type of sys define in bases of Mass and energy

sys ⇌ surr^n — Mass & Energy → both transfer → open sys

ISOLATED SYSTEM

An isolated system is defined as in which the mass is fixed (No mass can cross the boundary of the system) and as well energy can not be transferred to its surrounding.

sys $\xrightarrow[\text{Energy ✓}]{\text{Mass ✓}}$ surr^n → open sys

sys $\xrightarrow[\text{Energy ✓}]{\text{Mass ✗}}$ surr^n → close sys

sys $\xrightarrow[\text{Energy ✗}]{\text{Mass ✗}}$ surr^n → isolated sys → boundary → insulater

→ close container

Q → 2L O_2 gas present in insulater Close Container.
↳ Heat → x ↳ Mass → x

above arrangement is a example of

a) open sys

b) Close sys

✓ c) isolated sys

d) All

Mass → ✗ ↑ Heat → ✗

Q. A well stoppered thermos flask contains some ice cubes. This is an example of.

(a) closed system

(b) open system

(c) isolated system ✓

(d) All

Q Worming ammonium chloride with sodium hydroxide in a test tube is an example of.

(a) closed system

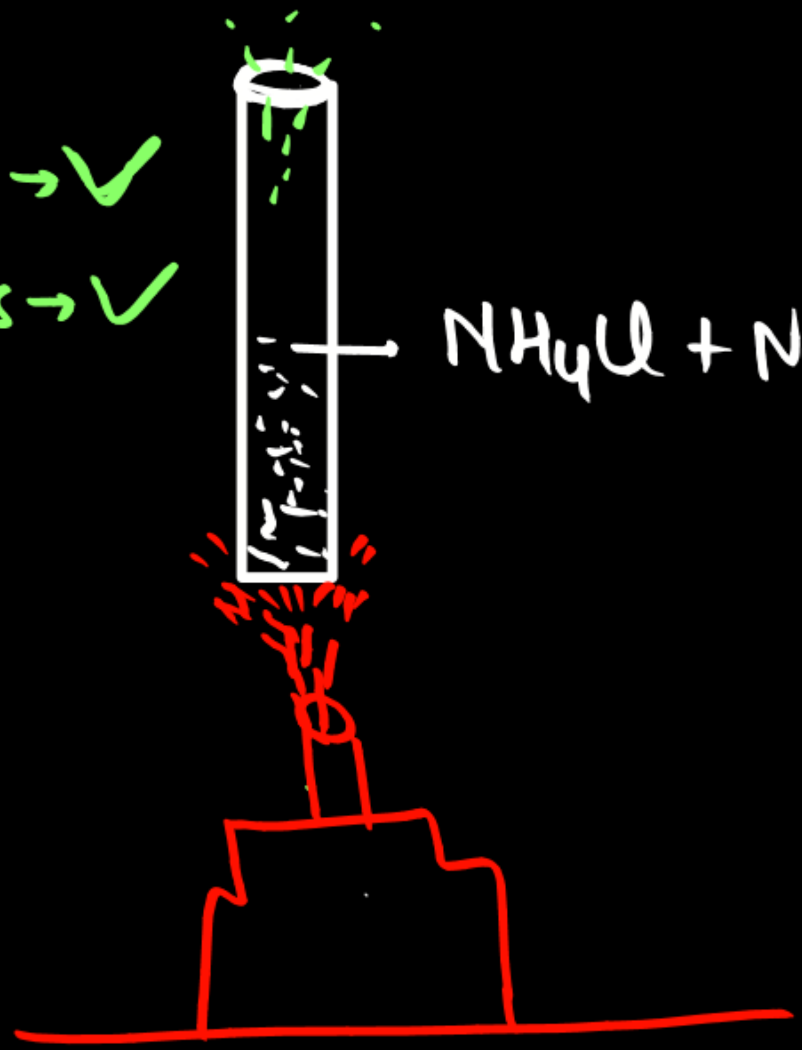
(b) isolated system

(c) open system ✓

(d) none of these

Heat → ✓

Mass → ✓



$NH_4Cl + NaOH \longrightarrow NH_3\uparrow + NaCl + H_2O$

INTENSIVE AND EXTENSIVE PROPERTIES → System

INTENSIVE

An intensive property is one that does not depend on the mass of the substance or system

- → temperature
- → pressure → $P = \frac{n}{V}RT$ (n → Kam, V → Kam, fixed)
- → Concentration →
- → Density

EXTENSIVE

An extensive property of a system depends on the system size or the amount of matter in the system.

- → Length
- → Mass or amount
- → Volume
- → $K.E = \frac{1}{2}mu^2$
- → $P.E = mgh$
- → Charge
- → Energy
- → Mole
- → Internal energy
- → Enthalpy (energy)
- → Gibbs free energy
- → Area

Molar Heat capacity	Entropy
Specific heat capacity	Heat capacity
C_p, C_v	

Mass % $= \dfrac{n_{solute} \rightarrow Ext^{v}}{n_T \rightarrow Ext^{v}}$

↓

Int^{v}

$M = \dfrac{n_{solute} \rightarrow Ext^{v}}{V_{soln} \rightarrow Ext^{v}}$

↓

Inte^{v}

$m = \dfrac{n_{solute} \rightarrow Ext^{v}}{M_{solvent} - Ext^{v}}$

|

Int^{v}

Q → select intensive prop^{r}.

a) mole

b) litre

c) $\dfrac{\text{mole} \rightarrow Ext^{v}}{\text{litre} - Ext^{v}}$ ✓

d) All

density $= \dfrac{\text{Mass} \rightarrow Ext^{v}}{\text{Volume} - Ext^{v}}$

Int^{v}

Ex → Equilibrium Const (K_c, K_p, K_{eq})

dissociation Const of Acid & Base (K_a, K_b, K_{sp})

K_w → all intensive

→ p^H, p^{OH} = intensive

→ Electrode potential ⇒ $E = \frac{\Delta G \to Ext^v}{nF \to Ext^v}$

E ↓ int^v

$\Delta G = -nFE$

$E = -\frac{\Delta G \to Ext^v}{nF}$

nF → charge → Ext^v

n ↓ mole of e^-

$P = \frac{Force \to Ext^v}{Area \to Ext^v}$

P ↓ Int^v

Viscosity → int^v

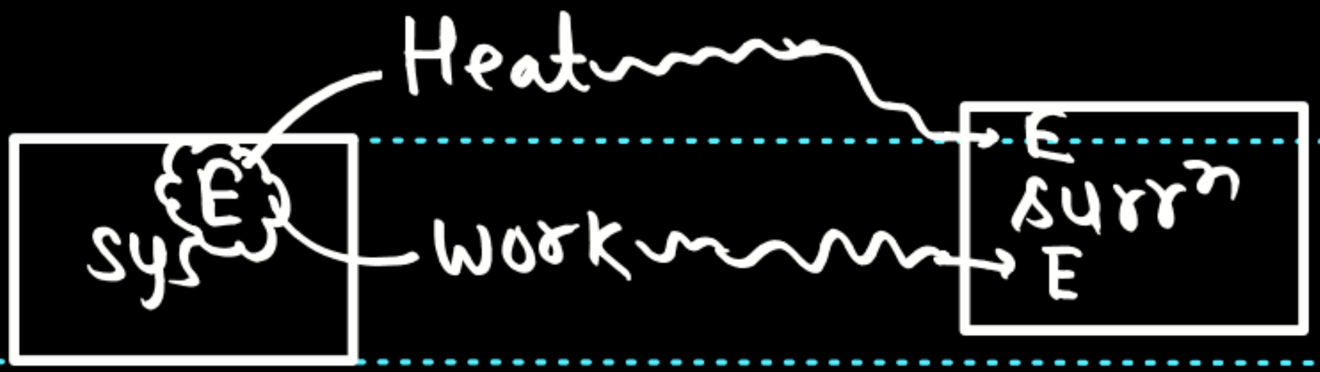
Gibbs free energy → Ext$^{\checkmark}$

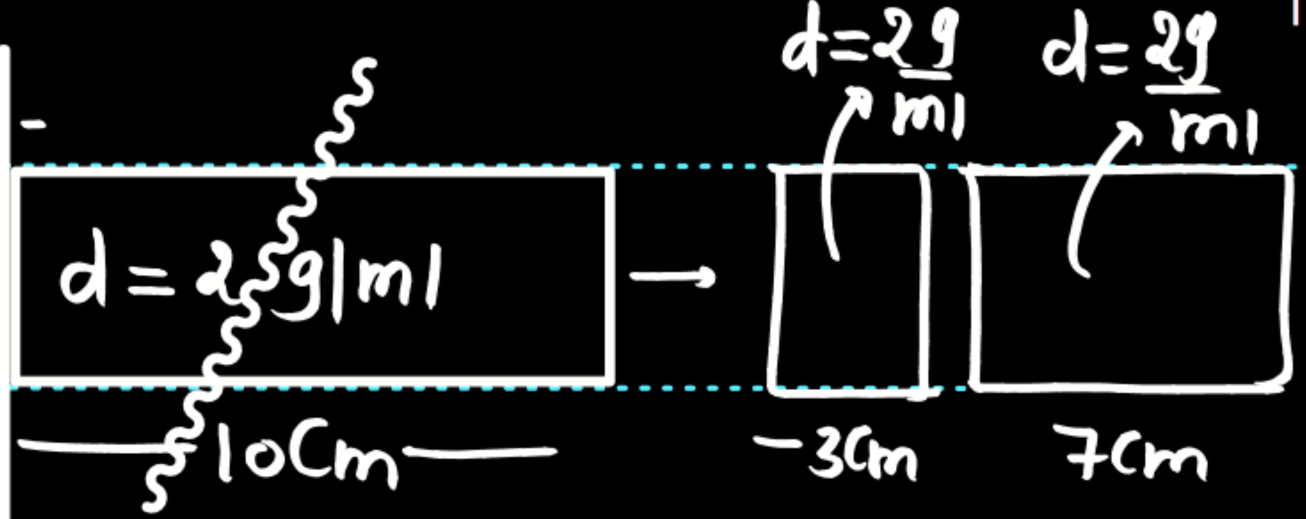
mole → Ex$^{\checkmark}$

Gibbs free energy per mole = $\dfrac{\Delta G \rightarrow \text{Ext}^{\checkmark}}{n \rightarrow \text{Ext}^{\checkmark}}$

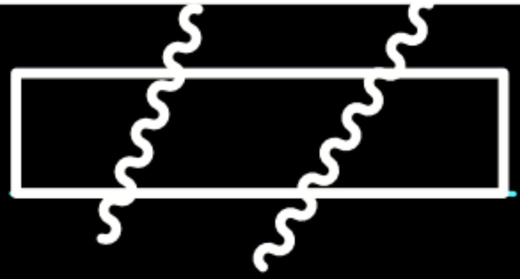
↓

Intensive





10 = 3+7

CSD  → by part → property Ki value change ho jaye

→ Extensive aur yadi na change ho → Intensive

→ $\frac{\text{Extensive}}{\text{Extensive}}$ Ratio = Intensive

→ Note → Work & Heat = Not Int^{v} | Ext^{v}

↳ Boundary $prop^{r}$.

→ Int^{v} $prop^{r}$ does not Additive in nature

→ Ext^{v} $prop^{r}$ → Additive in nature

Question 1. select the intensive and extentive properties in given example

Example	Intensive	Extensive
Amount		✓
Mass		✓
Mole		✓
Density	✓	
Heat	✗	✗
Force		✓
Heat	✗	✗
Work	✗	✗
Molarity	✓	
Mass by mass	✓	
Mass Percentage	✓	
molality	✓	
Volume by Volume Percentage	✓	
Mass of one mole	✓	

Pressure	✓	
Temperature	✓	
Volume		✓
Gibbs Free Energy		✓
Gibbs free energy per mole	✓	
Internal energy		✓
Internal energy per mole	✓	
Heat Capacity		
Molar heat capacity		
Specific heat capacity		
Molar heat capacity at constant pressure		
Molar heat capacity at constant volume		

Surface tension	✓	
pH of solution	✓	
Ecell of cell	✓	
Standard electrode potential	✓	
Enthalpy of reaction		✓
Enthalpy per mole	✓	
Entropy		✓
Area, length		✓
Boiling point	✓	
Melting point	✓	
Freezing point	✓	
Viscosity	✓	
Refractive index	✓	

Q. Which is the intensive property?

(a) temperature
(b) viscosity
(c) density
(d) all

Q. Which is the extensive property?

(a) temperature ✗

(b) mole fraction ✗

(c) density ✗

(d) internal energy ✓

Q. Which is the extensive property?

(a) pressure ✗ (b) pH of solution ✗

(c) enthalpy ✓✓ (d) internal energy per mole ✗

Q. select the correct statement .

(a) extensive properties are additive in nature ✓

(b) intensive properties are additive in nature ✗

(c) radio of two extensive properties are intensive ✓

(d) all correct

a, c


THANK YOU

MANTHAN NEET 2025

CHEMISTRY

thermodynamics

Lecture-02

Qsd →



Sarvesh Sir

Today's Goal -

terminology

Qsd-1 one litre N_2 gas present in close insulator Container, select Correct option

Close ↓ Mass → x

insulator ↓ Heat → x

a) open sys

b) close sys

✓ c) isolated sys

d) All

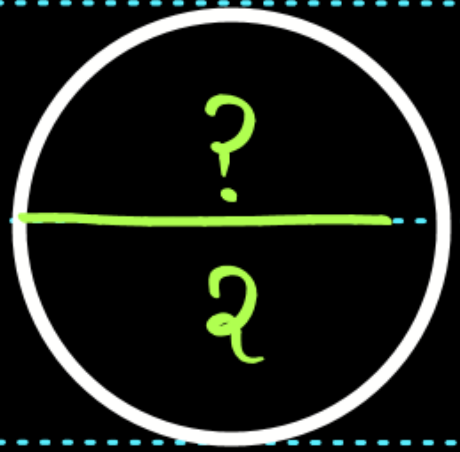
Qsd-2 select intensive propʳ

a) volume ✗

b) pH of solⁿ ✓✓

c) Gibbs free energy ✗

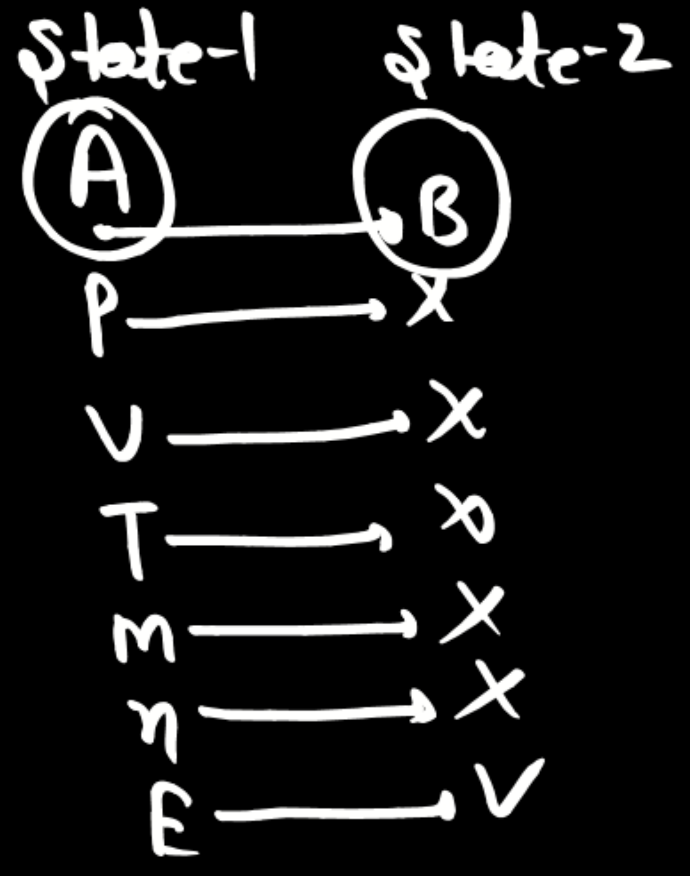
d) Mass ✗



PROCESS ,TYPE OF PROCESS AND STATE VARIABLE

PROCESS = *It is an operation by which a system undergoes a change from one state to another* (kisi system me kuch hone ko process kehete hai)

Example =



Q →

TYPE OF PROCESS

ISOTHERMAL PROCESS

A process in which the temperature remains constant throughout its course is called isothermal process.

i.e. $\Delta T = 0$

→ $T = Const$

→ $\Delta T = T_f - T_i = 0$

ISOBARIC PROCESS

A process during which pressure of the system remains constant is called isobaric process.

i.e. $\Delta P = 0$.

→ $P = Const$

→ dP or $\Delta P = 0$

ISOCHORIC PROCESS

A process during which volume of the system remains constant is called isochoric process.

i.e. $\Delta V = 0$.

→ $V = \text{Const}$

→ dV or $\Delta V = 0$

Q → 1 litre O_2 gas present in close Container at 200K temp.

If the temp. of sys increases 250K. select Correct option

× a) isothermal

× b) isobaric

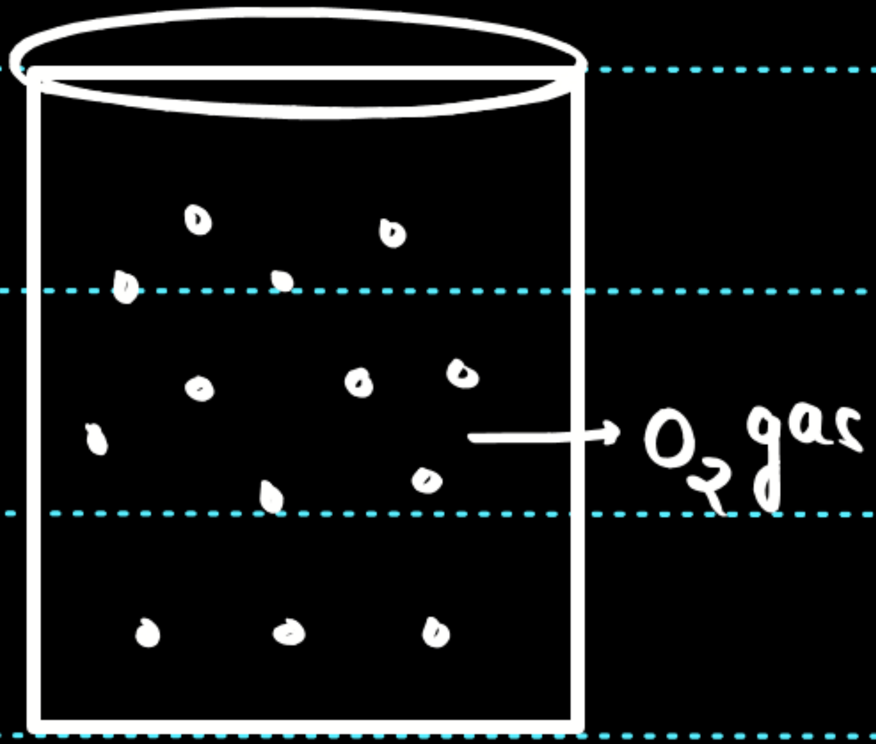
✓ c) isochoric

d) NONE

$T \rightarrow 200K \rightarrow 250K$

$PV = nRT$ (P and T circled; V, n, R marked ×)

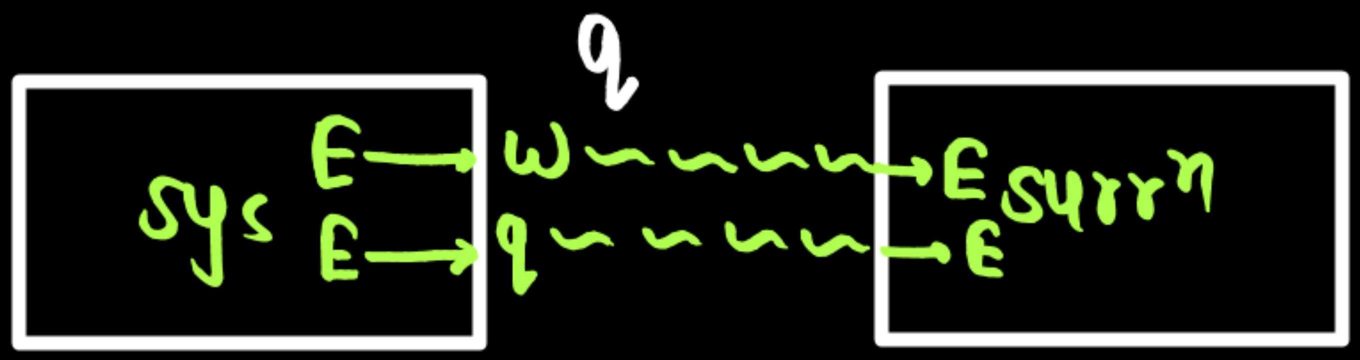
$K.E\uparrow = \frac{1}{2} mu\uparrow$ → Collision → pressure



ADIABATIC PROCESS

A process during which no heat is exchanged between the system and the surroundings is called adiabatic process.

i.e. $dq = 0$.



$q = 0$

$dq = 0$

* Heat (q) and work (w) generate during the process (not store in sys)

* q and dq same bat hai
→ dono hi change Ko represent Kr rahe hai

* w and dw = same bat hai

$q = 0$

Q→ 2 mole He gas present in close insoluted container, If temp. of sys (gas) increases 10°C. than select correct option (more than one Ans may be possible)

a) Isobaric process ✗

b) Isothermal ✗

c) Adiabatic ✓ → c, d

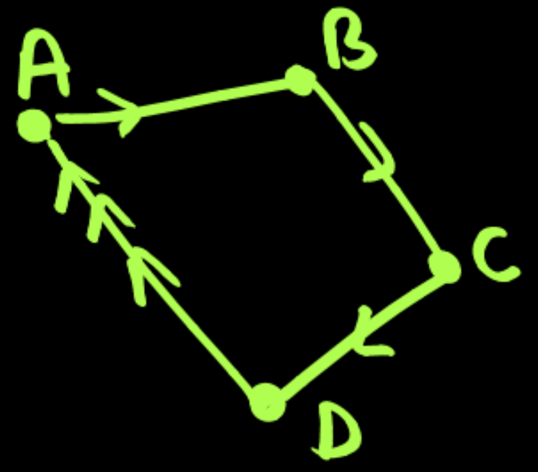
d) Isochoric ✓

CYCLIC PROCESS

A process during which state of the system does not change is called cyclic process.

i.e. $\Delta E = 0$ and also $\Delta H = 0$.

20-30 minute



→ initial state & final state → same hota hai

→ all state function → $\Delta U = 0$

$\Delta H = 0$

$\Delta G = 0$

$\Delta E = 0$

Q

A $\longrightarrow$ B $\longrightarrow$ C

(P_1, V_1, T_1) (P_2, V_1, T_1) (P_2, V_1, T_2)

Select Correct Answer

$T_1 \rightarrow T_2 \Rightarrow$

✗ a) A $\longrightarrow$ B = isobaric $\rightarrow$ P = Const

✗ b) B $\longrightarrow$ C = isothermal $\rightarrow$ T = Const

✓ c) A $\longrightarrow$ B = isothermal $\rightarrow$ T = Const

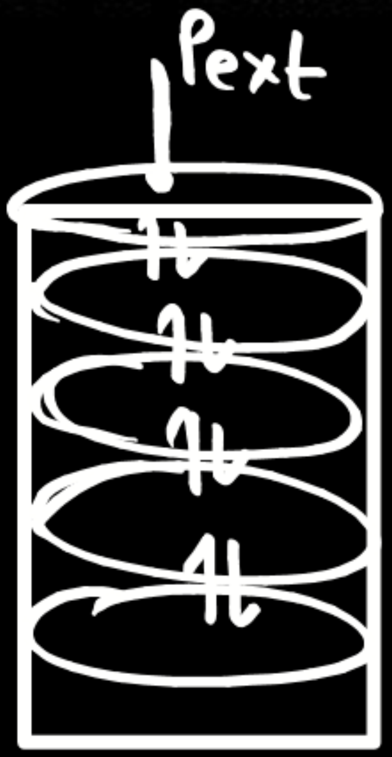
✗ d) A $\longrightarrow$ C = Adiabatic ✗

REVERSIBLE AND IRREVERSIBLE PROCESS

MODES OF PROCESS (KAM KRNE KE TARIKA)

REVERSIBLE PROCESS

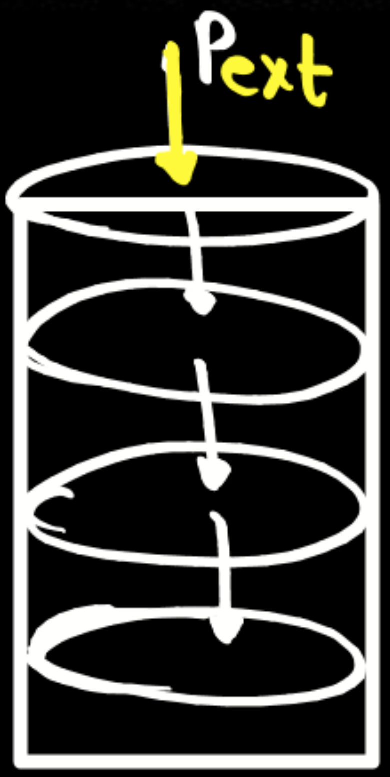
A process in which the driving force is infinitesimally greater than the opposing force is called reversible process.



→ present in Equilbri-um
→ infinite time
→ infinite step
→ theoretical process
→

IRREVERSIBLE PROCESS

A process in which direction can not be altered by small changes in variables like P, V, T etc. is called irreversible process.



→ Directional
→ finite time
→ finite step
→ all natural process are example of irreversible process

P_{ext} = Variable	→ P_{ext} = Constant
→ Non-directional	→ Real process
→ Hypothetical process	
→ equal tendency to move both direction	

Q. In thermodynamics, a process is called reversible when

(a) surroundings and system change into each other

(b) there is no boundary between system and surroundings

(c) the surrounding are always in equilibrium with the system

(d) the system changes into the surrounding spontaneously

Q → 2 mole N_2 gas present in Close Container at 300K temp and 1bar pressure. If sys change state V → 10L → 15L at 300K temp and 1bar pressure. Select correct option

a) Reversible isothermal

b) irreversible isochoric ✗

c) irreversible isothermal

d) All incorrect

Q. A system X undergoes following changes
The overall process may be called

X W Z Z

(a) reversible process
(b) cyclic process
(c) cyclic as well as reversible
(d) isochoric process

STATE FUNCTION AND PATH FUNCTION

State function

1. Only depend upon initial and final state of system
2. any number of steps results in the same value



Path function

1. Depend upon path of process
2. Different steps result in different values

→ depend — ① initial state & final state
② path (Rasta)

→ distance
→ work
→ Heat
→ Heat capacity

→ displacement

→ Internal energy

→ Enthalpy

→ Gibbs free energy

→ Entropy

→ temperature

→ Volume

→ Pressure

Q. 2 select state function and path function in given example

Example	State function	Path function
Work 1		✓
Heat 2		✓
Volume 3	✓	
Pressure 4	✓	
Internal energy 5	✓	
Gibbs free energy 6	✓	
Enthalpy 7	✓	
Entropy 8	✓	
Heat capapcity 9		✓
Temperature 10	✓	
No. of mole 11	✓	

Q. Which one is not a state function? → Path

(a) internal energy (E)

(b) volume

(c) heat

(d) enthalpy

Q. Which one is a state function?

(a) heat ✗

(b) work ✗

(c) Gibbs free energy ✓

(d) enthalpy ✓

c, d

Select Correct option

a) $w_1 = w_2$ ✗

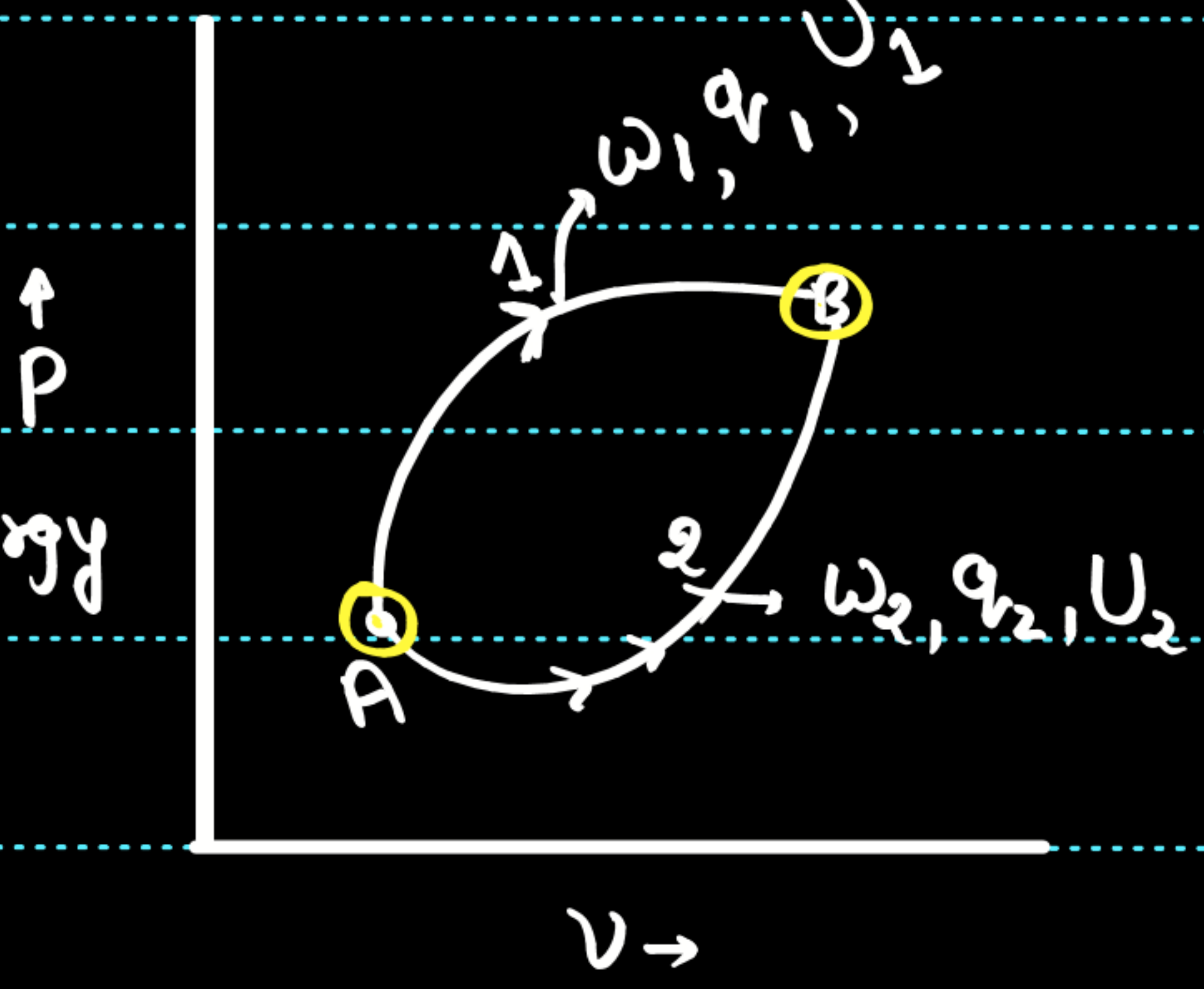
b) $q_1 = q_2$ ✗

c) $U_1 = U_2$ ✓

d) All Correct

path [w = work
q = Heat]

U = internal energy → state functⁿ





→ 7pm live

today → Mon → fri

→ Mole Concept

→ only NCERT

MANTHAN NEET 2025

CHEMISTRY

thermodynamics

Lecture-03



Sarvesh Sir

Qsd-1. How many properties are example of state function work, heat , temperature , pressure , distance , electrode potential

(a) 1 (b) 2

(c) 3 (d) 4

distance

work

heat

heat capacity

Qsd-2 1 mole liquid water present in a open tube test at 298k temperature is example of .

Mass → ✓, Energy → ✓

(a) closed system

(b) isolated system

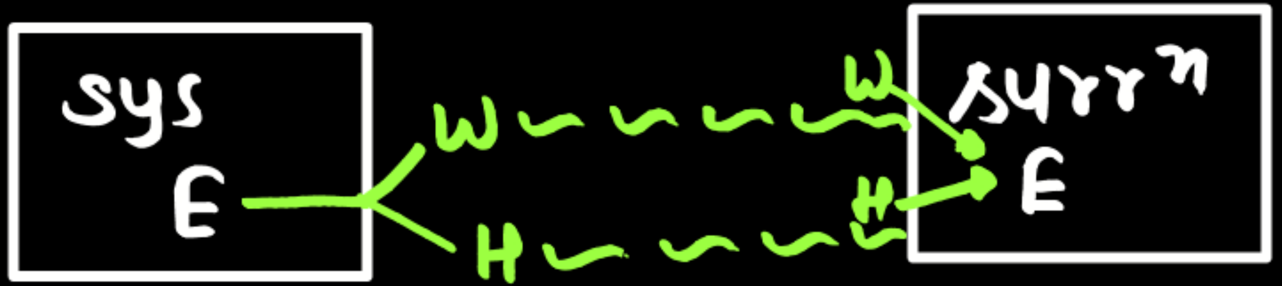
(c) open system ✓

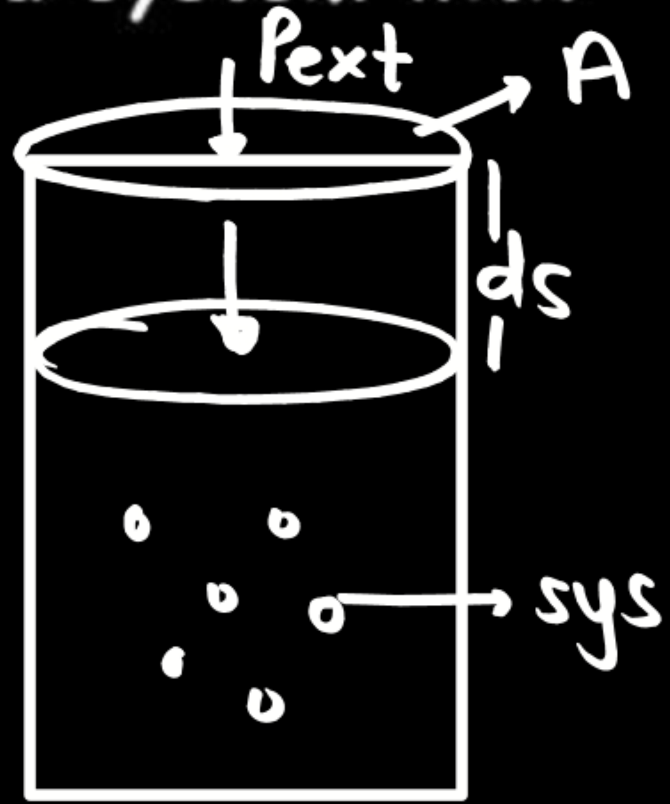
(d) none of these

$\frac{?}{2}$

WORK

Work is defined as energy transfer to or from a system with reference to the surroundings





$$P = \frac{F}{A}$$

$$F = P \times A$$

$$W = F \times ds$$

$$W = P \times A \times ds = P \times dV$$

$$\boxed{W = P \times dV}$$

Work → motion against opposing force

$$W = -P_{ext}\,dV = -P_{ext}(V_f - V_i)$$

Reason → w ka sign Physics aur Chemistry opposite

→ Path function

Work on the system → Compression

$$W = -P_{ext}\,dV = -P_{ext}(V_f - V_i)$$

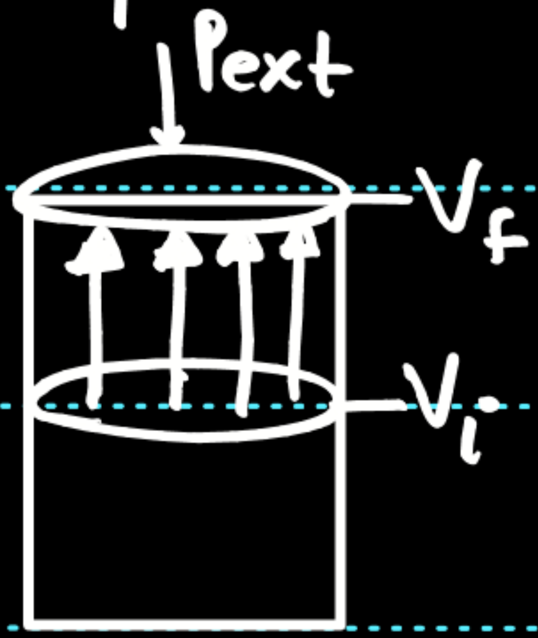
$W = +ve \ (V_f < V_i)$



V_i

V_f

Work by the system – Expansion



$$W = -P_{ext}\,dV$$

$$W = -P_{ext}(V_f - V_i)$$

$$W = -ve \quad (V_f > V_i)$$

$$W = -P_{ext} \times dV$$

$$W = \underline{atm \times litre}$$

CSD → Work = motion against opposing force

$W = -P_{ext}dV = -P_{ext}(V_f - V_i)$

→ Path function

→ boundary properties (not int^v, not ext^v)

→ Work done on the system (Compression)

$W = -P_{ext}(V_f - V_i) = +ve \quad (V_i > V_f)$

→ Work done by the system (Expansion)

$W = -P_{ext}(V_f - V_i) = -ve \quad (V_f > V_i)$

Work done against vaccuumm

$W = 0 \rightarrow P_{ext} = 0$

Work done in free expansion → $W = 0 \rightarrow P_{ext} \rightarrow 0$

Unit of work = atm × litre

→ 1 atm × litre = 101 Joule

→ 1 bar litre = 100 Joule

CSD → 1 pascal × litre = 1×10^{5} Joule

→ 1 Joule = 1×10^{7} erg

→ 1 Calorie = 4.18 ≃ 4.2 Joule

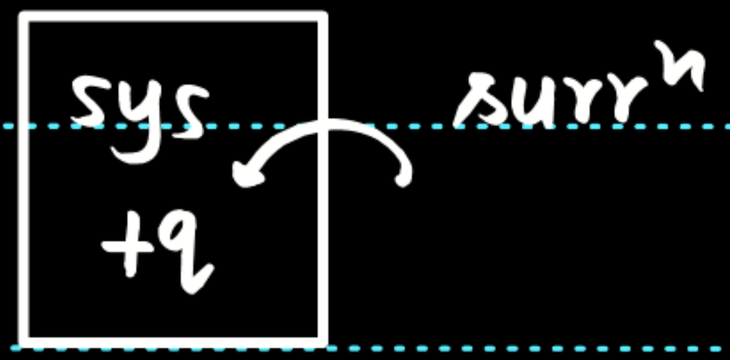
→ Only calculate P-V work

→ Energy → flow or transfer → in term of **Heat** →

when $T_{sys} \neq T_{surr^n}$

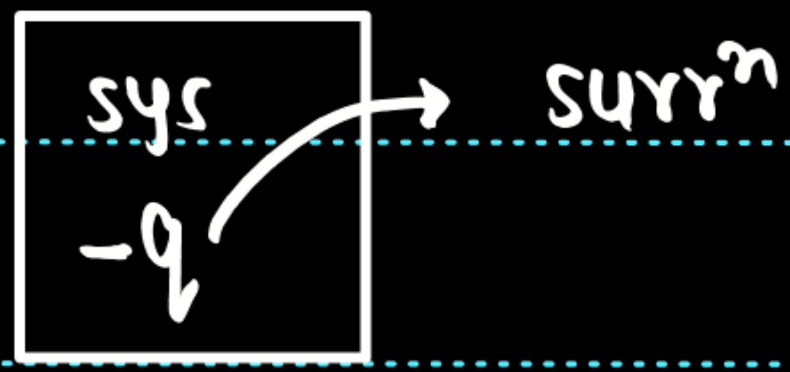
→ Represent → q or dq (same bat hai)

→ Heat ka flow ⇒ high temp ⟶ low temp



$q_{sys} = +ve$ (sys = absorbed)

$q_{surr^n} = -ve$ ($surr^n$ = release)



$q_{sys} = -ve$, $q_{surr^n} = +ve$

(release) (gain)

C_{SD} → insulator wall → Heat → q or dq = 0

→ q or dq and w or dw → same bat hai

dono hi change ko show krte hai

An ideal gas is allowed to expand from 1 L to 10 L against a constant external pressure of 1 bar. The work done in kJ is:

V_i V_f P_{ext}

(2019 Main, 12 April I)

↓ FYQ → NEET-2025

(A) –9.0

(B) +10.0

(C) –0.9 ✓

(D) –2.0

$$W = -P_{ext}(V_f - V_i)$$

$$W = -1\,bar(10L - 1L)$$

$$= -9\,bar \times litre = -9 \times 100\,Joule = -\frac{9 \times 100}{1000}\,kJ = -0.9\,kJ$$

Q33. The work done during the expansion of a gas from a volume of 4 dm^3 to 6 dm^3 against a constant external pressure of 3 atm, is V_i V_f [CBSE AIPMT 2004]

(a) –6 J
(b) –608 J
(c) +304 J
(d) –304 J

$$W = -P_{ext}(V_f - V_i)$$

$$1\,dm^3 = 1\,litre$$

$$= -3\,atm \times (6L - 4L)$$

$$= -6\,atm \times litre$$

$$= -6 \times 101\,Joule$$

$$= -606\,Joule$$

Q→ 2 mole N_2 gas present in 10L close container at 300K temp and 1atm pressure, If the gas expaned to 20L, Calculate work done by gas against voccuumm

$P_{ext} = 0$

a) − 10 atm×litre

b) − 101×10 atm×litre

c) = +10 atm×litre

d) zero

$W = 0$

HEAT

The energy that flows across the boundary of a system during a change in its state by virtue of a difference in temperature between the system and its surroundings and flows from a point of higher to a point of lower temperature.



$T_{sys} = T_{surr^n}$ → Energy does not transfer in term of heat

$T_{sys} \neq T_{surr^n}$ → Transfer of energy done by in term of Heat b/w sys and surr^n

Internal Energy

Sum of all kind of energy of system is known as internal energy of system

Represent → E or U → mainly

$$U = P.E + K.E. + E_{rot} + E_{elec} + E_{vib} + E_g + \cdots$$

CSD → Internal Energy = sum of all kind of energy of system

Represent → E or U

→ U = absolute value = not Countable

→ dU or ΔU = Change of internal E. = Countable

→ Extensive properties

→ Internal E per gram, Internal E per mole

& Internal per volume = Intensive prop^r

$\frac{U}{w}$, $\frac{U}{n}$, $\frac{U - Ext^V}{V - Ext^V}$

→ State function ***

**** → Internal energy of ideal gas

Only depend upon temperature

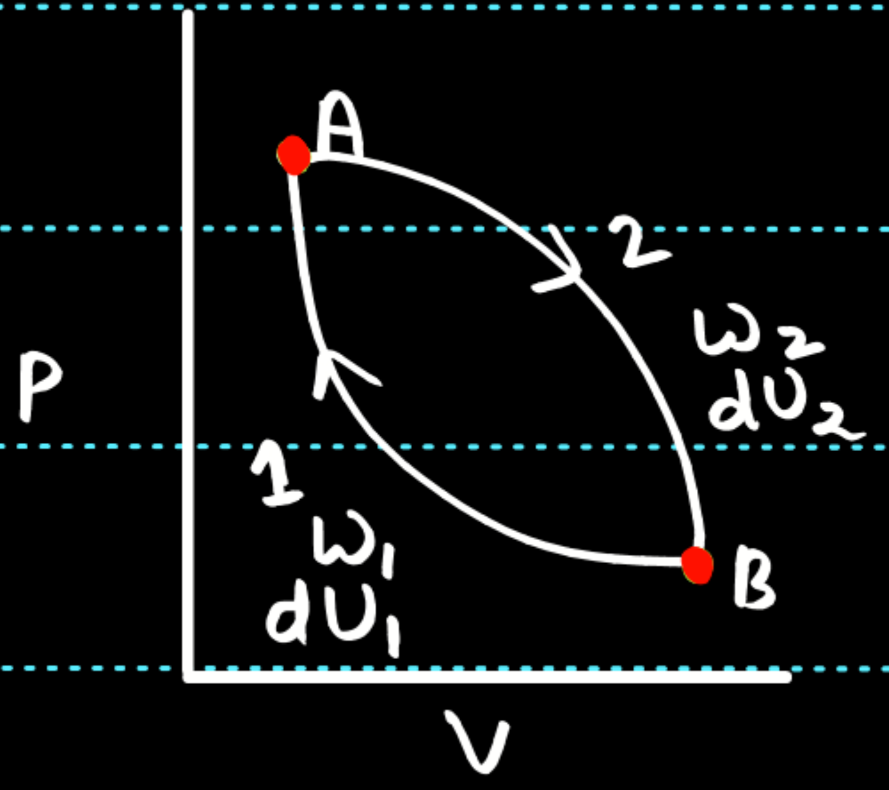
$U = f(T) \rightarrow dU = 0$ at Const T

$\left(\frac{dU}{dP}\right)_T = 0$, $\left(\frac{dU}{dV}\right)_T = 0$

$\left(\frac{dU}{dT}\right)_P \neq 0$ $\left(\frac{dU}{dT}\right)_V \neq 0$

Q → Above graph draw b/w P Vs V at Constant temp. for 2 mole of N_2 gas.

Select Correct option



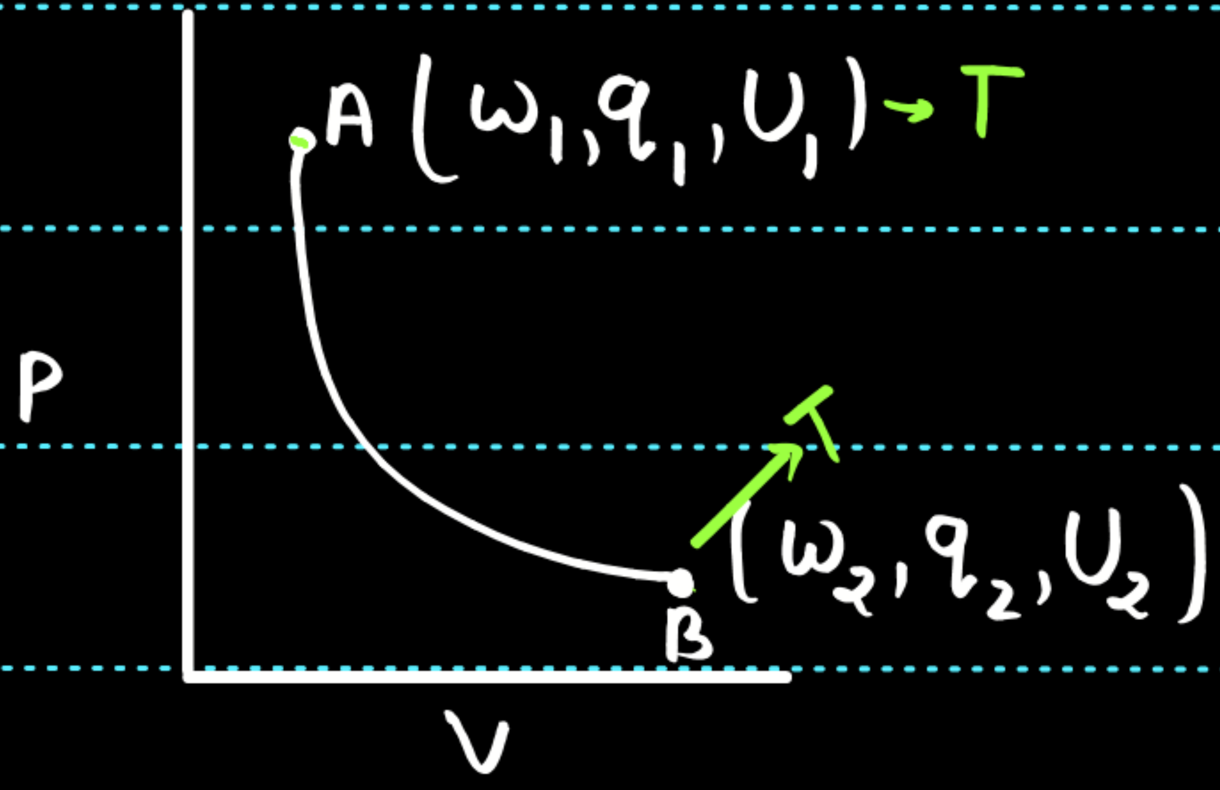
a) $w_1 = w_2$ W = path fun

✓ b) $dU_1 = dU_2$ dU = State fun

✓ c) $w_1 \neq w_2$ b, c

d) $dU_1 \neq dU_2$

Q → Above graph draw b/w P Vs V at Constant temp. for 2 mole of N_2 gas.



Select Correct option

a) $w_1 = w_2$

b) $q_1 = q_2$

c) $U_1 = U_2$ ✓

d) all incorrect

$U = f(T)$

$dU = 0$ at Const

$U_f = U_i \Rightarrow U_2 = U_1$

1^{st} law of Thermodynamics

Energy neither be created nor be destoryed, only Convert one form energy to another form of energy

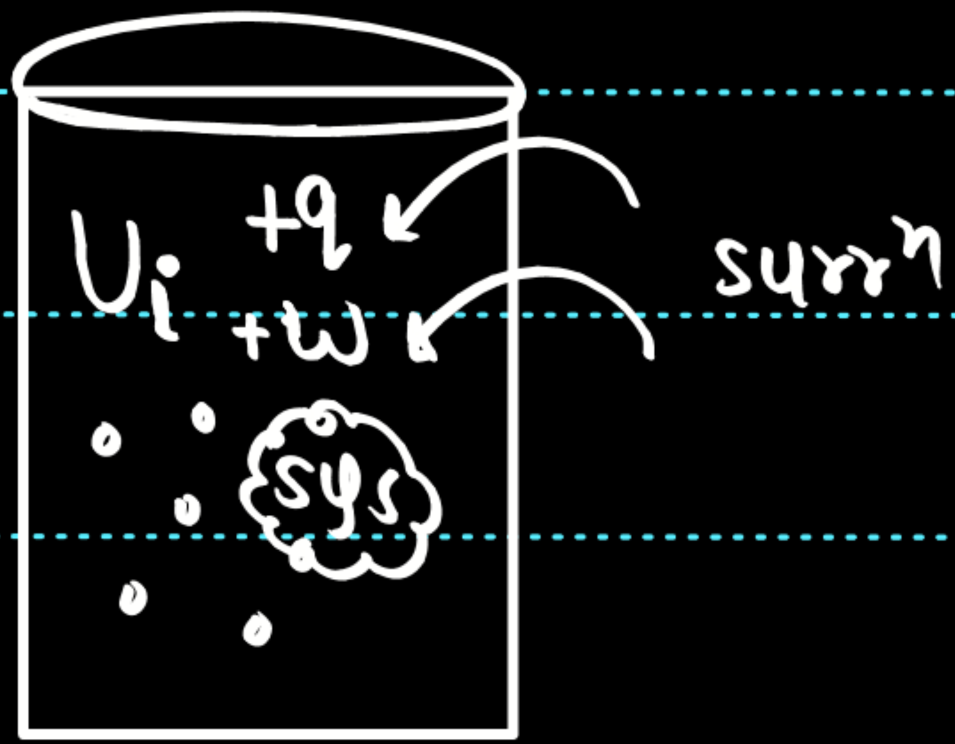
$U_f = U_i + q + w$

$U_f - U_i = q + w$

$dU = q + w$ → general Equat^n of 1^{st} law

or

$dU = dq + dw$



* $U = q + w$ → ✗ not likh sakte

CSP → 1^{st} law of thermodynamics

→ $dU = q + w$ or $dU = dq + dw$

→ $dU = q - P_{ext} dV$

$W = +ve$ $W = +10\,kJ$ $-q_{sys}$

During compression of a spring the work done is 10 kJ and 2 kJ escaped to the surroundings as heat. The change in internal energy, ΔU (in kJ) is:

(2019 Main, 09 April II)

(A) 8 ✓
(B) –12
(C) 12
(D) –8

$dU = q + \omega$

$dU = -2 + 10 = +8\,kJ$

Q44. In a closed insulated container a liquid is stirred with a paddle to increase the temperature, which of the following is true? **[CBSE AIPMT 2002]**

(a) ⊗E = W ≠ 0, q = 0

(b) ⊗E = W = 0, q ≠ 0

(c) ⊗E = 0, W = q ≠ 0

(d) W = 0, ⊗E = q ≠ 0

$q = 0$

T = change

$q = 0$

$dU = q + w$

$dU = w \neq 0$

Q17. Which one of the following is correct option for free expansion of an ideal gas under adiabatic condition?

[CBSE AIPMT 2011]

(a) $q \neq 0, \otimes T = 0, W = 0$

(b) $q = 0, \otimes T = 0, W = 0$

(c) $q = 0, \otimes T < 0, W \neq 0$

(d) $q = 0, \otimes T \neq 0, W = 0$

$W = 0$

$q = 0$

$dU = q + w$

$dU = 0$

$U = f(T)$

$T = \text{Const} \rightarrow dT = 0$

Q47. When 1 moles gas is heated at constant volume, temperature is raised from 298 to 308K. Heat supplied to the gas is 500 J. Then, which statement is correct?

[CBSE AIPMT 2001]

(a) $q = W = 500$ J, $\otimes E = 0$

(b) $q = \otimes E = 500$ J, $W = 0$

(c) $q = -W = 500$ J, $\otimes E = 0$

(d) $\otimes E = 0$, $q = W = -500$ J

$V = \text{Const} \rightarrow dV = 0$

$+q$

$W = -P_{ext} dV = -P_{ext} \times 0$

$W = 0$

$dU = q + W$ ($W = 0$)

$dU = q = +500$ J

THANK YOU
All the Best!! 👍

MANTHAN NEET 2025

CHEMISTRY

thermodynamics

Lecture-04

NYTS-2.0
1499Rs
Last day
↓
1999Rs



Sarvesh Sir

Qsd-1 2mole ideal gas present in close container at Constant temp (T). If gas expanded 5L to 10L at Constant temp. select correct option.

$dU = 0$

a) $w \neq 0$

b) $q \neq 0$

c) $dU = 0$ ✓

d) ~~All Correct~~

$dU = q + w$

$0 = q + w$

$q = -w \neq 0$

Qsd-2 Select state function

a) dU (marked)

× b) Heat capacity

× c) work

× d) Heat

$\frac{?}{2}$

w, q, Heat capacity, distance → path

1^{st} law of thermodynamics in different process

$$dU = q + w = q - P_{ext}dV$$ → general form of 1^{st} law

dU = internal energy chang

dq or q = Heat transfer b/w sys and surr^n

dw or w = work done of process (Expanded or Compression)

$dU = q + w$ → General form

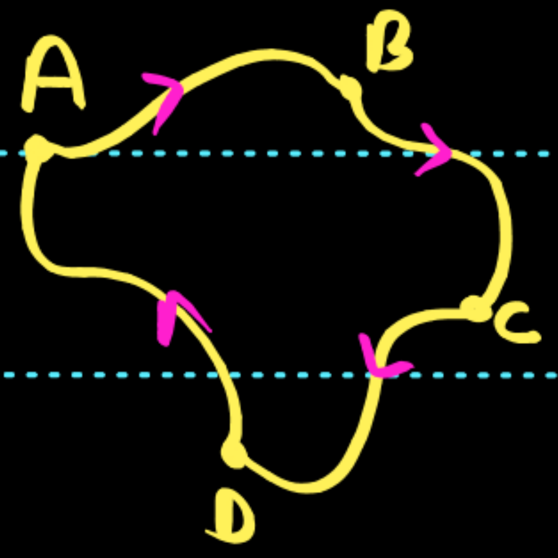
$w = -P_{ext}\,dV$

- **isothermal process** → $T = \text{Const}$, $\Delta T = 0$, $dU = 0$ → $w = -q$
- **Isobaric process** → $P = \text{Const}$, $dp = 0$, $dU = q + w$
- **IsoChoric process** → $V = \text{Const}$, $dV = 0$ → $w = 0$; $dU = q_v$ → Heat at Const volume (q_v) = STATE Funct?
- **Adiabatic process** → q or $dq = 0$ → $dU = w$

work done in Adiabatic process is a state funct?

5. → **cyclic process** → $dU = 0$

$W = -q$



ΔU is equal to:

(2017 Main)

(A) isochoric work

(B) isobaric work

(C) adiabatic work

(D) isothermal work

$dU = q + w$ (q → 0)

$dU = w \rightarrow q = 0 \rightarrow$ Adiabatic process

Which one of the following equations does not correctly represent the first law of thermodynamics for the given processes involving an ideal gas? (Assume non-expansion work is zero)

(2019 Main, 08 April I)

(A) Cyclic process : $q = -W$

(B) Adiabatic process : $\Delta U = -W$

(C) Isochoric process : $\Delta U = q$

(D) Isothermal process : $q = -W$

$dU = q + w$

A) $dU = 0 \rightarrow w = -q$ or $q = -w$

B) $q = 0 \Rightarrow dU = w$

C) $dV = 0 \rightarrow w = 0 \Rightarrow dU = q$

D) $dU = 0 \Rightarrow w = -q$

Q44. In a closed insulated container a liquid is stirred with a paddle to increase the temperature, which of the following is true? **[CBSE AIPMT 2002]**

(a) $\otimes E = W \neq 0,\ q = 0$

(b) $\otimes E = W = 0,\ q \neq 0$

(c) $\otimes E = 0,\ W = q \neq 0$

(d) $W = 0,\ \otimes E = q \neq 0$

$q = 0$

$dU = w + q \Rightarrow dU = w \neq 0$

Q47. When 1 moles gas is heated at constant volume, temperature is raised from 298 to 308K. Heat supplied to the gas is 500 J. Then, which statement is correct?

[CBSE AIPMT 2001]

(a) q = W = 500 J, ⊗E = 0

(b) q = ⊗E = 500 J, W = 0

(c) q = –W = 500 J, ⊗E = 0

(d) ⊗E = 0, q = W = –500 J

$dV = 0$, $w = 0$

$q = +500\,J$

$dU = q + w$ ($w \to 0$)

$dU = q = +500\,J$

Enthalpy of system

lab → open test tube or open Container ⇒ P=Constant

$P = P_{atm} = 1 atm$

Enthalpy = total store energy of the system

Enthalpy Change is equal to Heat at Constant pressure

$dH = q_p$

Enthalpy → Reperesent → H , $H = U + PV$

Csd ⇒ Extensive prop^r

→ Enthalpy per mole → $\frac{dH}{n}$
→ Enthalpy per gram → $\frac{dH}{w}$ } intensive prop^r
→ Enthalpy per volume → $\frac{dH}{V}$

→ STATE Function

→ $H = f(T)$ for ideal gas

Enthalpy of ideal gas only depend upon temperature ($T = Const \Rightarrow dH = 0$)

$\left(\frac{dH}{dV}\right)_T = 0$, $\left(\frac{dH}{dP}\right)_T = 0$

$\left(\frac{dH}{dT}\right)_P \neq 0$, $\left(\frac{dH}{dT}\right)_V \neq 0$

→ Enthalpy → Absolute value does not Countable

→ Change in enthalpy (dH) = Coun-table

$$H = U + PV$$

$$dH = d(U + PV) = dU + d(PV)$$

$$dH = dU + d(PV)$$

↓

**** P = Constant

$$dH = dU + PdV$$

at Constant pressure

P = Variable

NEET → nahi aya hai

$$dH = dU + (P_f V_f - P_i V_i)$$

$$dH = dU + d(PV)$$

↓

$$dH = dU + d(nRT) \quad (\because PV = nRT)$$

$dH = dU + nRdT$	$dH = dU + \Delta n_g RT$
→ Reaction = not occurs	Reaction = occurs → $dn = \Delta n_g$ = total gaseous mole of prd − total gaseous mole React^n.
→ temperature = change	temp = Const

$$\Delta n_g = n_P - n_R$$

$$dH = dU + \Delta n_g RT$$

- $\Delta n_g = 0$
  - $dH = dU$
- $\Delta n_g > 0$, +ve
  - $dH > dU$
- $\Delta n_g = -ve$, $\Delta n_g < 0$
  - $dH < dU$

$$dH - dU = \Delta n_g RT$$

or

$$q_p - q_v = \Delta n_g RT$$

Q → $3H_2(g) + N_2(g) \longrightarrow 2NH_3(g)$

$\Delta n_g = 2 - (3+1) = -2$

Q → $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$

$\Delta n_g = 1 - 0 = 1$

Q → $H_2(g) + 2O_2(g) \longrightarrow 2H_2O(l)$

$\Delta n_g = 0 - (1+2) = -3$

$\Delta n_g = ?$ a) 0 ~~b)~~ -3

c) 3 d) NONE

Q17. Which one of the following is correct option for free expansion of an ideal gas under adiabatic condition?

[CBSE AIPMT 2011]

(a) $q \neq 0, \otimes T = 0, W = 0$

(b) $q = 0, \otimes T = 0, W = 0$

(c) $q = 0, \otimes T < 0, W \neq 0$

(d) $q = 0, \otimes T \neq 0, W = 0$

The difference between ΔH and ΔU (ΔH – ΔU), when the combustion of one mole of heptane (ℓ) is carried out at a temperature T, is equal to:

(A) –4RT
(B) 3RT
(C) 4RT
(D) –3RT

$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O(l)$
(l) (g) g

$\Delta n_g = 7 - 11 = -4$

$dH - dU = ?$, $dH - dU = \Delta n_g RT$
$= -4RT$

Q52. If ⊗E is the heat of reaction for

$C_2H_5OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(l)$ at constant volume, the ÄH (heat of reaction at constant pressure), then the correct relation is

$\Delta n_g = 2 - 3 = -1$

[CBSE AIPMT 2000]

(a) ⊗H = ⊗E + RT

(b) ⊗H = ⊗E – RT

(c) ⊗H = ⊗E – 2RT

(d) ⊗H = ⊗E + 2RT

$dH = dU + \Delta n_g RT$

Q66. For the reaction:

$N_2 + 3H_2 \rightleftharpoons 2NH_3$, ⊗H = ? **[CBSE AIPMT 1991]**

(a) ⊗E + 2RT

(b) ⊗E – 2RT ✓

(c) ⊗H = RT

(d) ⊗E – RT

$\Delta n_g = 2 - 4 = -2$

$dH = dU + \Delta n_g RT$

$= dU - 2RT$

Q37. For the reaction, $C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$ at constant temperature, $\otimes H - \otimes E$ is

[CBSE AIPMT 2003]

H.W. 3-6=-3

(a) +3RT
(b) –RT
(c) +RT
(d) –3RT

The difference between heats of reaction at constant pressure and constant volume for the reaction

dH   dU

$$2C_6H_6(\ell) + 15O_2 \rightarrow 12CO_2(g) + 6H_2O(\ell)$$

NEET-2025 - - -

at 25°C in kJ is:

12-15 = -3

R = 8.314 Joule

(A) –7.43
(B) +3.72
(C) –3.72
(D) +7.43

$$dH - dU = \Delta n_g RT = -3 \times 8.314 \times 10^{-3}\,kJ \times 298\,K$$

$$= -7432.7 \times 10^{-3}\,kJ$$

$$= -7.43\,kJ$$

Heat capacity

– total heat required to rise 1°C or 1K temp of any matter



Represent → C

→ Extensive prop^r

→ path function

$dT\,K \longrightarrow dq$ or q

$1K \longrightarrow \frac{q}{dT}$

formula → $C = \frac{dq}{dT}$ or $\frac{q}{dT}$ or $\frac{q}{\Delta T}$

Heat capacity → C

$\frac{C}{m} =$ **Specific heat capacity**

total heat required to rise 1°C or 1K temp for 1 gram matter

Represent → s or C_s

$$q = mC_s\Delta t = ms\Delta t$$

$\frac{C}{n}$ **Molar heat capacity**

total heat required to rise 1°C or 1k temperature for 1 mole matter

n mole = C

1 mole = $\frac{C}{n} \Rightarrow C_m$

q = heat required

m = mass of matter

s or C_s = specific heat capacity

ΔT = temp. change

→ Intentive prop^r = $\frac{C \to Ext^v}{m - Ext^v}$

Represent → C_m

$$C_m = \frac{C}{n} = \frac{q}{n \Delta T}$$

$$\boxed{q = n C_m \Delta T}$$

Intensive prop^r

THANK YOU
All the Best!! 👍

MANTHAN NEET 2025

CHEMISTRY

thermodynamics

Lecture-05

qsd = ?



Sarvesh Sir

Qsd-1

A piston filled with 0.04 mole of an ideal gas expands reversibly from 50.0 mL to 375 mL at a constant temperature of 37.0°C. As it does so, it absorbs 208 J of heat. The values of q and W for the process will be:

($R = 8.314$ J/mol K, $\ln 7.5 = 2.01$)

$q = +208\,J$

$W = -208\,J$

$dU = 0$

$dU = q + W \Rightarrow W = -q$

(A) $q = +208$ J, $W = -208$ J

(B) $q = -208$ J, $W = -208$ J

(C) $q = -208$ J, $W = +208$ J

(D) $q = +208$ J, $W = +208$ J

Qsd-2. If ⊗H is the change in enthalpy and ⊗E, the change in internal energy accompanying a gaseous reaction, then

$\Delta H = \Delta U + \Delta n_g RT$

(a) ⊗H is always greater than ⊗E

(b) ⊗H < ⊗E only if the number of moles of products is greater than the number of moles of the reactants

(c) ⊗H is always less than ⊗E

(d) ⊗H < ⊗E only if the number of moles of products is les than the number of moles of the reactants

$\Delta n_g = 0 \rightarrow \Delta H = \Delta U$

$\Delta n_g > 0 \rightarrow \Delta H > \Delta U \longrightarrow \Delta n_g > 0 \rightarrow n_P > n_R$

$\Delta n_g < 0 \rightarrow \Delta H < \Delta U \longrightarrow \Delta n_g < 0 \rightarrow n_P < n_R$

$\frac{?}{2}$

Q40. The molar heat capacity C of water at constant pressure is 75 JK^{-1} mol^{-1}, when 1.0 kJ of heat is supplied to 100g of water which is free to expand, the increase in temperature of water is [CBSE AIPMT 2003]

(a) 4.8 K
(b) 6.6K
(c) 1.2K
(d) 2.4K

2 moles of an ideal gas expanded isothermally and reversibly from 1 L to 10 L at 300 K. What is the enthalpy change?

(2004, 1M)

(A) 4.98 kJ
(B) 11.47 kJ
(C) –11.47 kJ
(D) 0 kJ

Q55. One mole of an ideal gas at 300 K is expanded isothermally form an initial volume of 1 L to 10L. The ÄE for this process is ($R = 2 cal\ mol^{-1}\ K^{-1}$) [CBSE AIPMT 1998]

(a) 163.7 cal

(b) zero

(c) 1381.1 cal

(d) 9L atm

2 moles of an ideal gas expanded isothermally and reversibly from 1 L to 10 L at 300 K. What is the enthalpy change?

(2004, 1M)

(A) 4.98 kJ

(B) 11.47 kJ

(C) –11.47 kJ

(D) 0 kJ

Among the following the set of parameters that represents path functions, is:

(a) $q + W$

(b) q

(c) W

(d) $H - TS$

(A) (a) and (d)

(B) (a), (b) and (c)

(C) (b), (c) and (d)

(D) (b) and (c)

Qsd-1 select extensive property in given example

(2004, 1M)

(A) Heat capacity

(B) specific heat capacity

(C) Molar heat capacity

(D) all

Qsd-2 what is value of ratio of molar heat capacity at constant pressure and molar heat capacity at constant volume for 2 mole of mono atomic ideal gas

(A) 5/3

(B) 1/R

(C)R

(D) NONE

Q55. One mole of an ideal gas at 300 K is expanded isothermally form an initial volume of 1 L to 10L. The ÄE for this process is ($R = 2cal\ mol^{-1}\ K^{-1}$) [CBSE AIPMT 1998]

(a) 163.7 cal

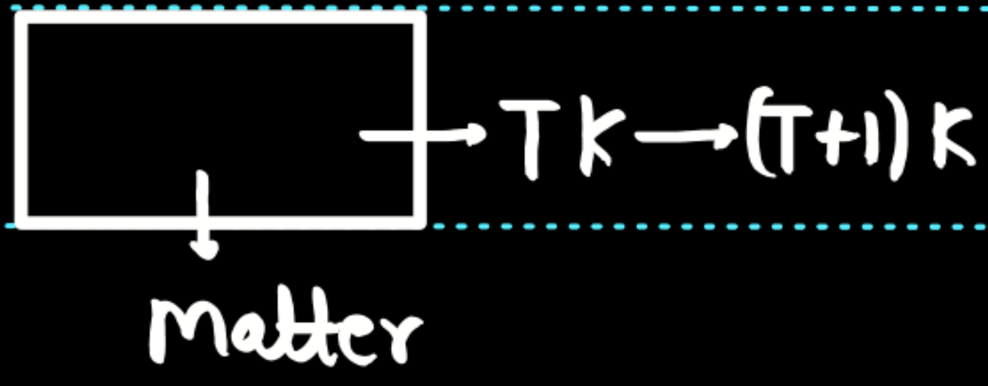
(b) zero

(c) 1381.1 cal

(d) 9L atm

Heat capacity

→ total heat required to rise 1°C or 1K temp of any matter



Represent → C

→ Extensive propʳ

→ path function

dT K → dq or q

1K → $\frac{q}{dT}$

formula → $C = \frac{dq}{dT}$ or $\frac{q}{dT}$ or $\frac{q}{\Delta T}$

Heat capacity $\rightarrow C$

$\frac{C}{m} =$ Specific heat capacity	$\frac{C}{n}$ Molar heat capacity
total heat required to rise 1°C or 1K temp. for 1 gram matter	total heat required to rise 1°C or 1K temperature for 1 mole matter
Represent → s or C_s	n mole $= C$
$q = mC_s\Delta t = ms\Delta t$	1 mole $= \frac{C}{n} \Rightarrow C_m$

13:3

q = heat required

m = mass of matter

s or C_s = specific heat capacity

ΔT = temp. change

→ Intentive prop^r = $\frac{C \rightarrow Ext^v}{m - Ext^v}$

Represent → C_m

$$C_m = \frac{C}{n} = \frac{q}{n\Delta T}$$

$$\boxed{q = n C_m \Delta T}$$

Intensive prop^r

Q40. The molar heat capacity C of water at constant pressure is 75 JK^{-1} mol^{-1}, when 1.0 kJ of heat is supplied to 100g of water which is free to expand, the increase in temperature of water is [CBSE AIPMT 2003]

(a) 4.8 K

(b) 6.6K

(c) 1.2K

(d) 2.4K ✓

$C_m = 75\ JK^{-1}$

$q = 1\ KJ = 1000$ Joule

$w = 100g$

$\Delta T = ?$

$q = n C_m \Delta T$

$1000 = \left(\frac{100}{18}\right) \times 75 \times \Delta T$

$\Delta T = \frac{36}{15}$

$= 2.4K$

MOLAR HEAT CAPACITY

→ C_m → $q = nC_m dT$

Molar heat capacity at constant Volume

Heat required to increase the temperature of one mole of the system by 1⁰ at constant volume.

→ Represent → C_v

$$q = nC_m \Delta T$$

$$q_v = nC_v \Delta T \Rightarrow dU = nC_v dT$$

$$(\because q_v = dU \rightarrow dw = 0)$$

Molar heat capacity at constant pressure

Heat required to increase the temperature of one mole of the system by 1⁰ at constant pressure

→ Represent → C_p

$$q = nC_m dT$$

$$q_p = nC_p dT \Rightarrow dH = nC_p dT$$

→ Intensive prop^r	Intensive prop^r
→ State funct^n	State function

Relation between C_p & C_v ⇒ Mayer's formula

$$dH = dU + nRdT$$

$$nC_p dT = nC_v dT + nRdT$$

$$nC_p \cancel{dT} - nC_v \cancel{dT} = nR\cancel{dT}$$

$$\boxed{nC_p - nC_v = nR}$$ → for n mole gas

$$\boxed{C_p - C_v = R}$$ → for 1 mole of gas

Q → select correct relation between C_p and C_v for 2 mole of ideal gas.

a) $C_p - C_v = R$

b) $C_v - C_p = R$

c) $2C_p - 2C_v = 2R$ ✓

d) $C_p - C_v = 2R$

$nC_p - nC_v = nR$

$n = 2$

$2C_p - 2C_v = 2R$

Q → why $C_p > C_v$ = ?

$C_p - C_v = \boxed{R}$ (workdone by the 1 mole gas at Const pressure) $\boxed{W = R}$

C_v → 1 mole gas → 1 K temp. increases at Const volume

V = Const, $dV = 0$ → $\boxed{W = 0}$ → $\boxed{q_v = dU}$

C_p → 1 mole gas → 1 K temp increases at Const. pressure (Volume = Variable)

P = Const, $W \neq 0$ → $dU = q + W = q - P_{ext}dV$

$q_p = dU + P_{ext}dV$

$C_p = C_v + P_{ext}dV$

CSD → Heat capacity → Int^{v} prop^{r},

→ $C = \frac{q}{\Delta T}$ or $\frac{dq}{\Delta T}$

→ unit = $\frac{J}{K}$ or JK^{-1}

→ Ext^{v} prop^{r}

→ path function

→ **Molar Heat capacity** = Heat capacity per mole

$$q = nC_m\Delta T$$, Int^{v} prop^{r}.

→ **Molar Heat capacity at Const. volume (C_v)**

$$q_v = nC_v dT \text{ or } dU = nC_v dT$$

→ **Specific heat capacity** → Heat capacity per gram

$$q = mC_x\Delta T$$

CSD **Molar Heat capacity at Const pressure (C_p)**

$q_p = nC_p dT$ or $\boxed{dH = nC_p dT}$

→ $nC_p - nC_v = nR$ for n mole of gas

→ $C_p - C_v = R$ for 1 mole of gas ($n=1$)

→ Why $C_p > C_v$ = ?

Reason → gas work to increase 1K temp.

for 1 mole at Const pressure | $W = R$ for 1 mole gas)

($W = nR$ for n mole gas)

Q → $C_p - C_v = R$, In given formula, R represent is ___

a) Universal gas Const.

b) work done by the 1 mole of gas to rise 1K temp at Const volume

c) work done by the 1 mole of gas to rise 1K temp at Const pressure

d) NONE

degree of freedom (f)

Measure → Molecule Kitne direction, Kitni taraha se motion krta hai

direction → x, y, z → 1D, 2D, 3D

Motion → (1) translational motion

(2) Rotational motion

(3) Vibrational motion (x)

Each degree of feedam associate $K.E = \frac{1}{2}RT$ per mole or $\frac{1}{2}KT$ per molecule

$$K.E = \frac{f}{2}RT$$

(No. of d.o.f. = f)

Atomicity or Molecule	D.O.F (f)	$C_v = \frac{f}{2}R$	$C_p = \frac{(f+2)}{2}R$	$\gamma = \frac{C_p}{C_v} = \frac{(f+2)}{f}$ (poison ratio)
Mono-atomic He, Ne, Ar	3	$C_v = \frac{3R}{2}$	$C_p = \frac{5R}{2}$	$\gamma = \frac{5}{3} = 1.66$
Diatomic gas O_2, N_2, H_2, F_2	5	$C_v = \frac{5R}{2}$	$C_p = \frac{7R}{2}$	$\gamma = \frac{7}{5} = 1.4$
Triatomic gas				
(a) linear	7	$C_v = \frac{7R}{2}$	$C_p = \frac{9R}{2}$	$\gamma = \frac{9}{7} = 1.28$
(b) Non linear	6	$C_v = \frac{6R}{2} = 3R$	$C_p = 4R$	$\gamma = \frac{4}{3} = 1.33$

THANK YOU
All the Best!! 👍

MANTHAN NEET 2025

CHEMISTRY

thermodynamics

Lecture-06

Telegram
→ Sarveshdixit csd official



Sarvesh Sir

Qsd-1 select extensive property in given example

(2004, 1M)

(A) Heat capacity → Ext

(B) specific heat capacity → $\frac{C}{w}$

(C) Molar heat capacity → $\frac{C}{n}$

(D) all

Qsd-2 what is value of ratio of molar heat capacity at constant pressure and molar heat capacity at constant volume for 2 mole of mono atomic ideal gas

$\frac{C_p}{C_v} = ?$

(A) 5/3 ✓

(B) 1/R

(C) R

(D) NONE

$\frac{C_p}{C_v} = \gamma = \frac{f+2}{f}$

$= \frac{3+2}{3} = \frac{5}{3}$

$\frac{?}{2}$

degree of freedom (f)

Measure → Molecule Kitne direction, Kitni taraha se motion krta hai

direction → x, y, Z → 1D, 2D, 3D

Motion → (1) translational motion

(2) Rotational motion

(3) Vibrational motion (x)

Each degree of feedam associate $K.E = \frac{1}{2}RT$ per mole or $\frac{1}{2}KT$ per molecule

$$K.E = \frac{f}{2}RT$$

(No. of d.o.f. = f)

$R = K \times N_A$

Atomicity or Molecule	D.O.F (f)	$C_v = \frac{fR}{2}$	$C_p = \frac{(f+2)R}{2}$	$\gamma = \frac{C_p}{C_v} = \frac{(f+2)}{f}$ ↓ poison ratio
Mono-atomic He, Ne, Ar	3	$C_v = \frac{3R}{2}$	$C_p = \frac{5R}{2}$	$\gamma = \frac{5}{3} = 1.66$
Diatomic gas O_2, N_2, H_2, F_2	5	$C_v = \frac{5R}{2}$	$C_p = \frac{7R}{2}$	$\gamma = \frac{7}{5} = 1.4$
Triatomic gas				
(a) linear — $CO_2 \rightarrow O=C=O$	7	$C_v = \frac{7R}{2}$	$C_p = \frac{9R}{2}$	$\gamma = \frac{9}{7} = 1.28$
(b) Nonlinear — SO_2 = 	6	$C_v = \frac{6R}{2} = 3R$	$C_p = 4R$	$\gamma = \frac{4}{3} = 1.33$

Q → Calculate value of molar heat capacity at Constant pressure for Nitrogen gas (N_2)

↳ diatomic gas

($f = 5$)

a) $\frac{5}{3}R$

b) $\frac{7}{5}R$

$$C_p = \frac{f+2}{2}R = \frac{5+2}{2}R = \frac{7}{2}R$$

c) $\frac{5}{2}R$

~~d)~~ NONE

Q → What amount of Heat required to rise 2 mole of N_2 gas temp $10^\circ C$ at Constant pressure.

a) 70R Joule

b) 50R Joule

c) 30R Joule

d) NONE

$f = 5$

$q_p = n C_p dT$

$C_p = \frac{f+2}{2} R$

$= 2 \times \frac{7}{2} R \times 10$

$= \frac{7}{2} R$

$= 70R$ Joule

Work done in different process

Process ⇒ mode of process (work or process Krne Ka tariKa)

1) Reversible method

2) Irreversible method

Reversible method

Nondirectional

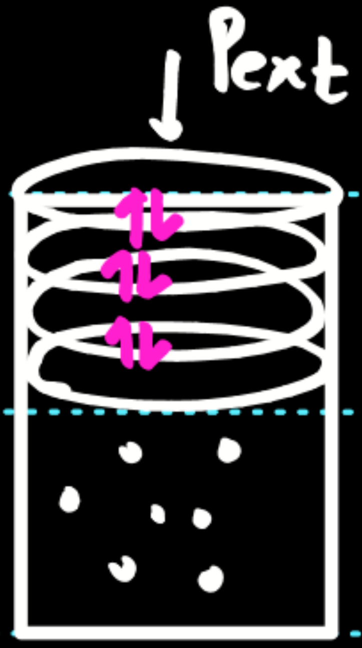
always Equilibrium

infinite time

infinite step

theoretical process (Hypothetical process)

*** Pext = Variable



Irreversible method

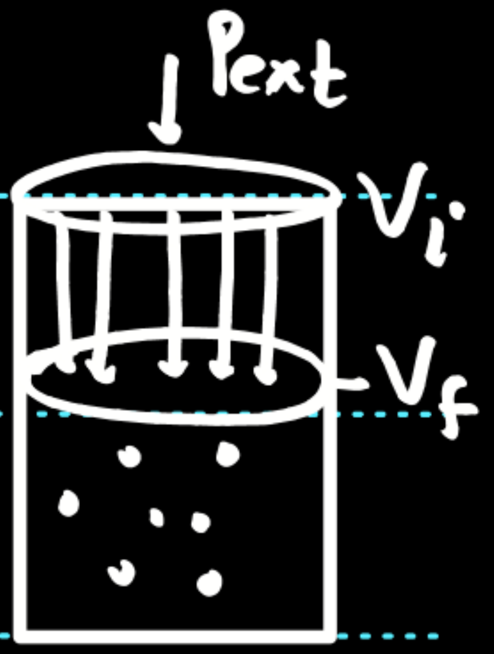
Directional method

finite time

finite step

*** Pext = Const

Real process → all natural process is a examble of irrevesible process



WORK DONE IN DIFFERENT PROCESS

Work done in Isothermal process

→ $T = Const, dT = 0$

Irreversible isothermal process

$$W_{irr} = -P_{ext} dV$$

$$\boxed{W_{irr} = -P_{ext}(V_f - V_i)}$$

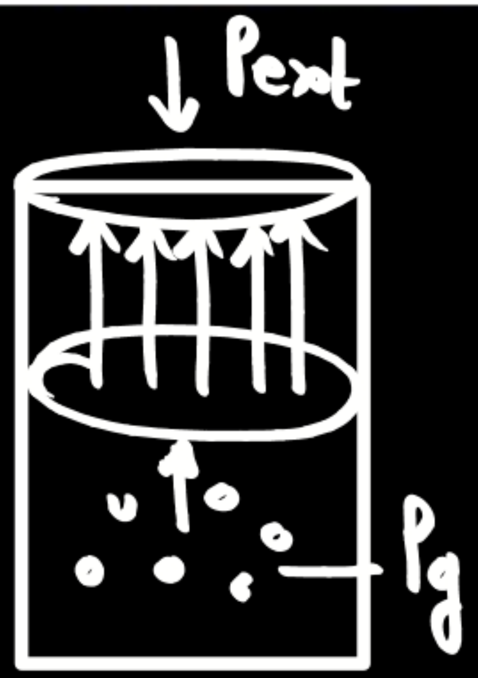
$$PV = nRT$$

$$V = \frac{nRT}{P}$$

Reversible isothermal process

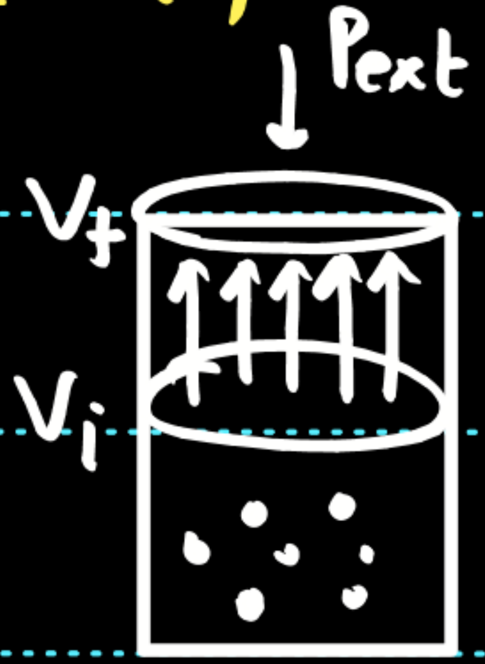
$$\int W_{Rev} = \int P_{ext} dV$$

$$W_{Rev} = -\int \frac{nRT}{V} dv$$



$P_g \simeq P_{ext}$

$$W_{irr} = -P_{ext}(V_f - V_i)$$



$$W_{irr} = -P_{ext}\left(\frac{nRT}{P_f} - \frac{nRT}{P_i}\right)$$

$$\boxed{W_{irr} = -P_{ext} \times nRT\left(\frac{1}{P_f} - \frac{1}{P_i}\right)}$$

$$W = -nRT\int_{V_i}^{V_f} \frac{1}{V}\,dV$$

$$W = -nRT\left[\ln V\right]_{V_i}^{V_f}$$

$$\boxed{W_{Rev} = -nRT\ln\frac{V_f}{V_i}}$$

$$W_{Rev} = -2.3032\,nRT\log\frac{V_f}{V_i}$$

$$\boxed{W_{Rev} = -nRT\ln\frac{P_i}{P_f}}\quad (\because P_iV_i = P_fV_f)$$

$$dU = 0$$

$$dH = 0$$

$$dU = q + w$$

$$0 = q + w$$

$$q = -w$$

$$q_{irr} = +P_{ext}(V_f - V_i)$$

$$q_{irr} = +P_{ext} \times nRT\left(\frac{1}{P_f} - \frac{1}{P_i}\right)$$

$$dU = 0$$

$$dH = 0$$

$$q_{rev} = -W_{Rev}$$

CSD

process	Work	Heat	dU	dH
Isothermal irreversible process	$W_{irr} = -P_{ext} dV$ $W_{irr} = -P_{ext}(V_f - V_i)$ $W_{irr} = -P_{ext} \times nRT \left(\frac{1}{P_f} - \frac{1}{P_i}\right)$	$q_{irr} = -W_{irr}$	$dU = 0$	$dH = 0$
Isothermal Reversible Process	$W_{Rev} = -nRT \ln \frac{V_f}{V_i}$ $W_{Rev} = -nRT \ln \frac{P_i}{P_f}$ $W_{Rev} = -P_i V_i \ln \frac{V_f}{V_i}$	$q_{rev} = -W_{Rev}$	$dU = 0$	$dH = 0$

CSD process	Work	Heat	dU	dH
Adaibatic process (Reversible and Irreversible	$W_{irr} = W_{Rev} = dU$ $W_{irr} = W_{Rev} = nC_v dT$	$q = 0$	$dU = nC_v dT$	$dH = nC_p dT$

2 moles of an ideal gas expanded isothermally and reversibly from 1 L to 10 L at 300 K. What is the enthalpy change?

(2004, 1M)

(A) 4.98 kJ
(B) 11.47 kJ
(C) –11.47 kJ
(D) 0 kJ

n, T, V_i, V_f, T = Const

dH = ?

dH = 0

dU = 0

Q55. One mole of an ideal gas at 300 K is expanded isothermally form an initial volume of 1 L to 10L. The ΔE for this process is (R = 2cal mol^{-1} K^{-1}) [CBSE AIPMT 1998]

(a) 163.7 cal

(b) zero

(c) 1381.1 cal

(d) 9L atm

n=1

T

T=Const

dH=0

dU=0

V_i

V_f

Q → Calculate work done by the 2 mole of gas expanded 10L to 20L Volume at Constant external pressure 2atm in isothermal Condition

1 atm × litre = 100 Joule

a) 20 Joule

b) 2000 Joule −2000 Joule ✓

c) 2 Joule +2000 Joule

d) 200 Joule

$$W_{irr} = -P_{ext}(V_f - V_i)$$

$$= -2atm(20L - 10L)$$

$$= -20 atm \times litre$$

$$= -20 \times 100 = -2000 \text{ Joule}$$

13:3
13:3

Q→ 2 mole O_2 gas expanded isothermally Reversible method form 10 L to 20 L volume at 1 atm, 300 K temp.

(annotations: n; T = Const; V_i; V_f; P; T)

Calculate heat required for expansion of gas (q_{rev})

a) − 10R J

b) − 60R J

c) + 60R J

d) NONE

$dH = 0$

$dU = 0$

$q_{rev} = -W_{Rev} = +414.5R$ Joule

$W_{Rev} = -nRT \ln\frac{V_f}{V_i} = -2.303 \times 2 \times R \times 300 \times \log\frac{20}{10}$

$W_{Rev} = -2.303 \times 2 \times R \times 300 \times 0.3$

$= -414.5R$ Joule

WORK DONE IN DIFFERENT PROCESS

Work done in adiabatic process → $q = 0$

Irreversible adiabatic process	Reversible adiabatic process
Note ⇒ $W = dU$ for adaibatic process └ STATE Function	$W_{irr} = W_{Rev} = dU$

$$dU = nC_v dT$$

→ $W_{irr} = W_{Rev} = dU = nC_v dT$

→ $W = -P_{ext} dV$

$dU = q + w$

Adiabatic → $q = 0$

$dU = w$

$w = dU$

↳ state function

Q → 4 gram Hydrogen gas present in Container at 300K temp (T_i)
(n)

Calculate work done (W) of H_2 gas, If temp rise 310K (T_f)

by adiabatic process ($q = 0$)

$H_2 \rightarrow$ diatomic

a) 150.7 J

$C_v = \frac{fR}{2} = \frac{5R}{2}$

b) 105.8 J

$W = dU = nC_v dT$

c) 170.5 J

$= \left(\frac{4}{2}\right) \times \frac{5R}{2} \times 10 = 50R$

~~d)~~ NONE

50×8.314 Joule $= 415.7$ Joule

Q→ Select correct option for adabatic expanssion of N_2 gas

$q = 0$

$W = dU$

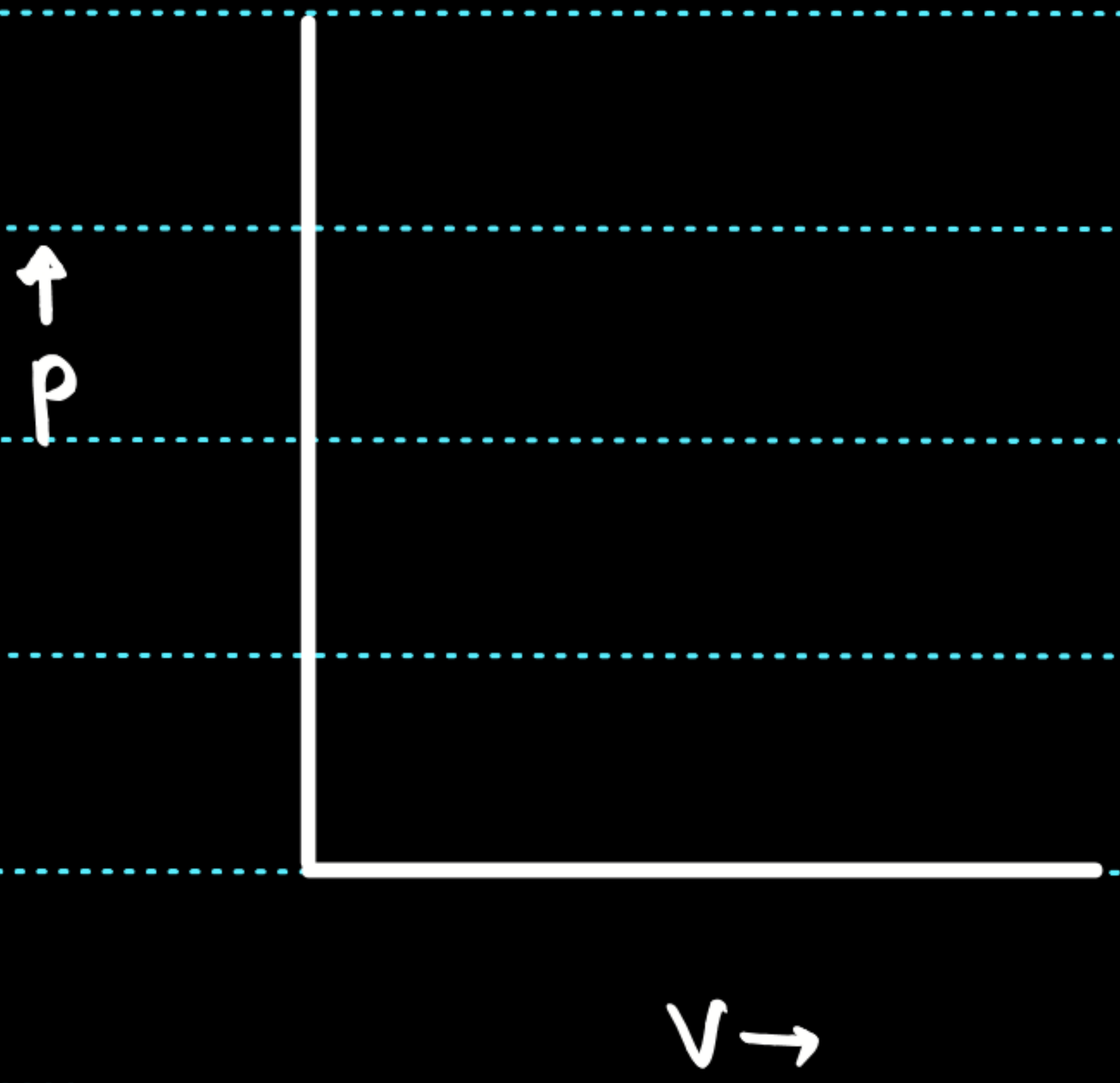
a) $W = dH$ ✗

b) $q = 0$ ✓

c) $W = dU$ ✓

d) All ✗

b, c


P
V

THANK YOU
All the Best!! 👍

MANTHAN NEET 2025

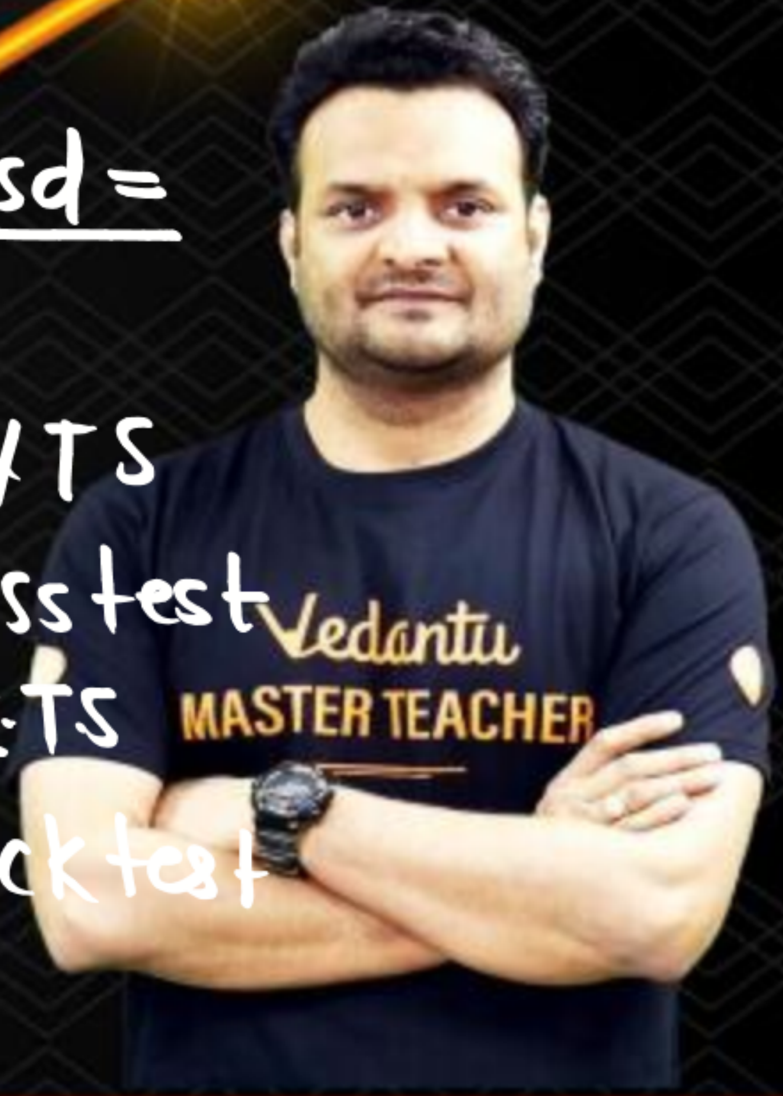
CHEMISTRY

thermodynamics

Lecture-07

Qsd =

1) → NYTS
2) → Class test
3) → AITS
4) → mock test



Sarvesh Sir

1) 2-subject practice - Books, package

2) Classes + Notes + Quest^n practices

3) 1 hr Revision

Q → 1 Select the correct Equation in which Heat at Const pressure is less than heat at Const volume.

$dH < dU$

(a) $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$ ✓

$2-4 = -2$

(b) $H_{2(g)} + I_{2(g)} \longrightarrow 2HI_{(g)}$ → $2-2=0$

(c) $2SO_{3(g)} \longrightarrow 2SO_{2(g)} + O_{2(g)}$ → $3-2=+1$

(d) All

$dH = dU + \Delta n_g RT$

$\Delta n_g = -ve$

$dH = dU - 2RT \rightarrow dH < dU$

Q→2) 2 mole ideal gas present in a 10L Container at 300K temp. gas absorbed heat at Const pressure and final temp. of gas is 400K, ($C_p = \frac{5}{3}$, $C_v = \frac{3}{2}$)

Calculate value of dH

(a) $\frac{500}{3}$ J

(b) $\frac{1000}{3}$ J ✓

(c) $\frac{100}{3}$ J

(d) $\frac{10}{3}$ Joule

$n = 2$ mole

$C_p = \frac{5}{3}$

$dT = 400 - 300 = 100K$

$dH = 2 \times \frac{5}{3} \times 100 = \frac{1000}{3}$ Joule

$dH = nC_p dT$

$dH = dU + \Delta n_g RT$] → (x)

$dH = dU + PdV$]

$\frac{?}{2}$

Isochoric process → V = Const

$dV = 0$

$W = -P_{ext} dV$

$W = -P_{ext} \times 0$

$W = 0$

$dU = q + w$

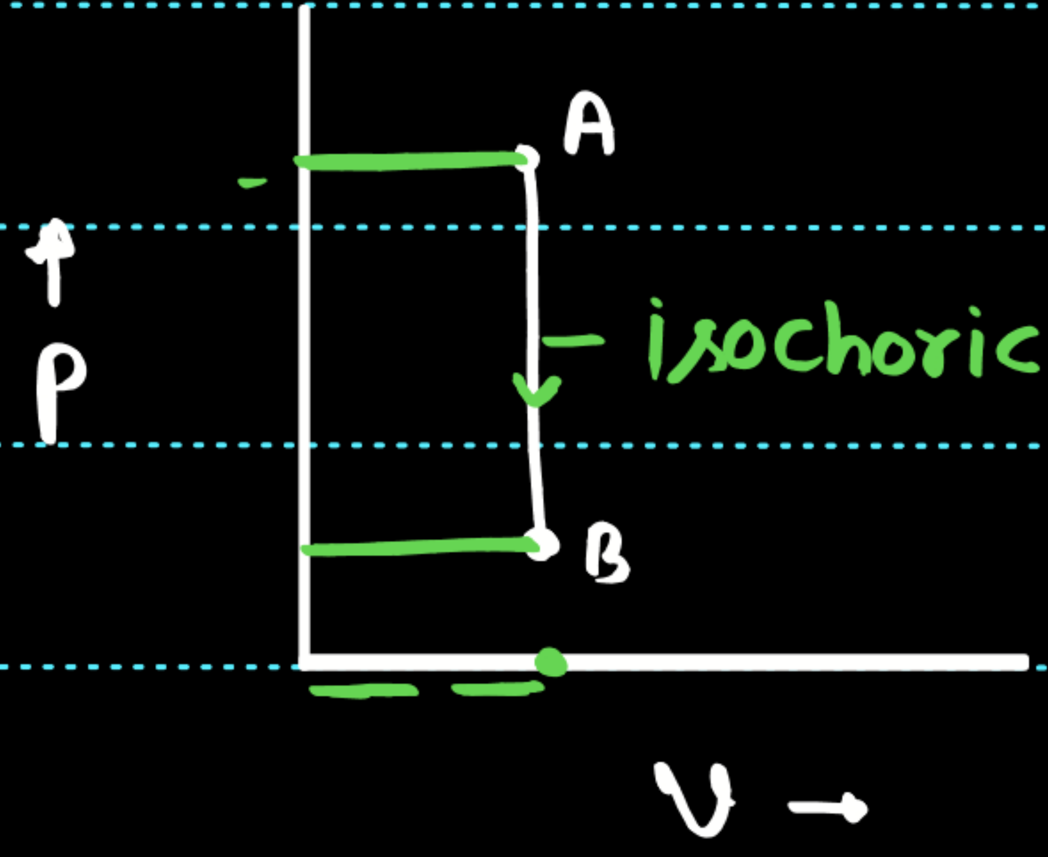
$dU = q + 0$

$dU = q_v$

$dU = nC_v dT$

$dH = nC_p dT$

Q →



a) $W = 0$

b) $W = +ve$

c) $W = -ve$

d) NONE

$V = Const$

$dV = 0$

$W = 0$

Select correct option for above given diagram

Isobaric process

$P = Const$, $dP = 0$

$$W = -P_{ext}dV$$

$$dU = q + W$$

$$q = dU - W$$

$$dU = nC_vdT$$

$$dH = nC_pdT$$

List-1 (process) | List-2

1) isochoric → a | a) $W = 0$

2) Adiabatic – b | b) $q = 0$

3) isobaric → e, → $dP = 0$ | c) $dU = 0$

4) isothermal – $dU = 0$, $dH = 0$ → c, d | d) $dH = 0$

(a, d) | e) $dP = 0$

a) 1 = a b) 2 = d, e

c) 3 – a, b d) 4 – c, d,

Q → which type of expansion work is greater for same change of volume for isothermal process.

a) W_{irr}

isothermal process → $W_{irr} \neq W_{Rev}$

✓ b) W_{Rev}

Csd → Expansion → $W_{1Step} < W_{2Step} ------ < W_{100Step} < W_{Rev}$

Compression $|W_{irr}| > |W_{Rev}|$

Q→ path-1 → (A) → (B)

path-2 → (A) → (C) → (B)

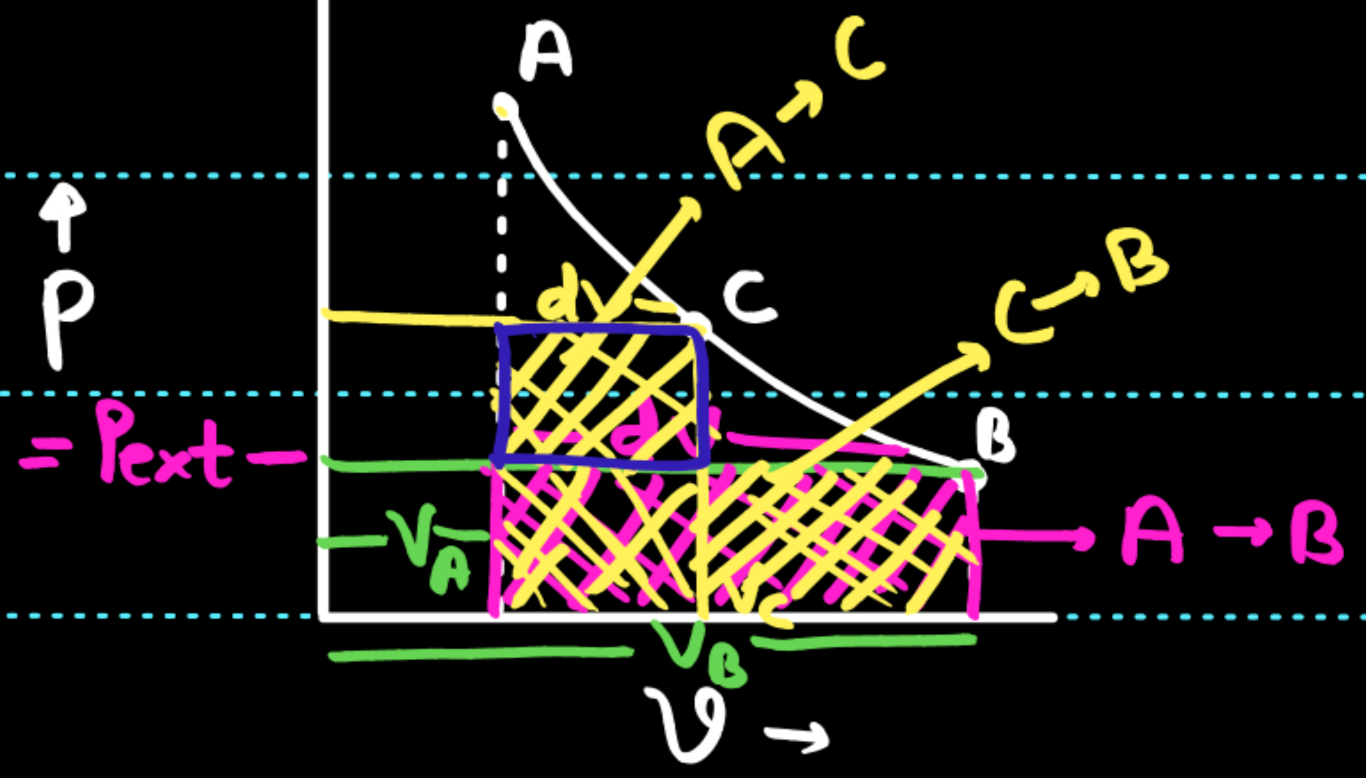
Select correct option

a) $W_1 > W_2$

b) $W_1 = W_2$

c) $W_1 < W_2$ ✓

d) Can not say



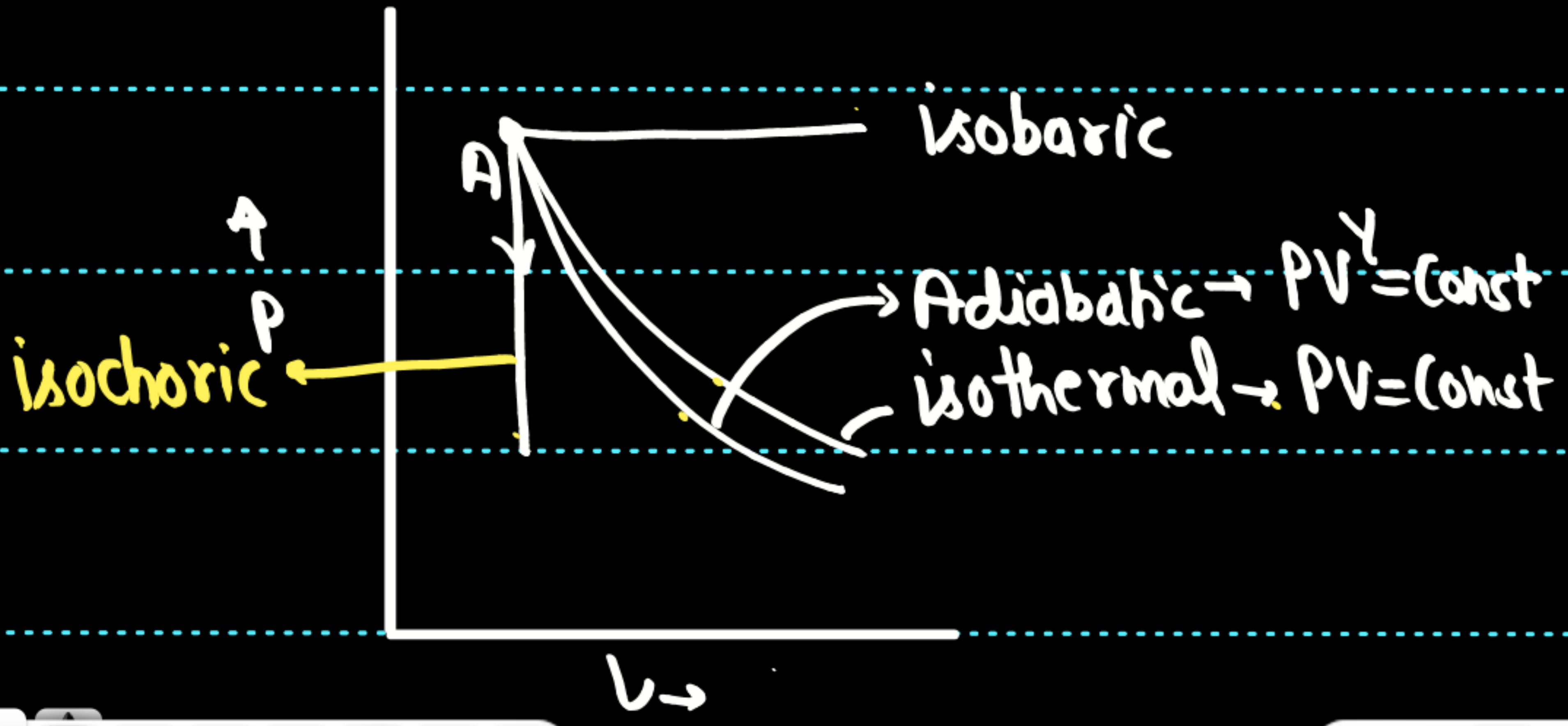
$W = -P_{ext} \times dV$

$y \times x$

$W = b \times l$

CSD → order of workdone for expansion process

$$W_{isobaric} > W_{isothermal} > W_{Adiabatic} > W_{isochoric}$$



Q → Select correct option for work done of isothermal and Adiabatic process.

a) $W_{iso} < W_{Adia}$

b) $W_{iso} > W_{Ad}$ ✓

c) $W_{iso} = W_{Ad}$

d) W is a state functⁿ → $W_{iso} = W_{Adia}$

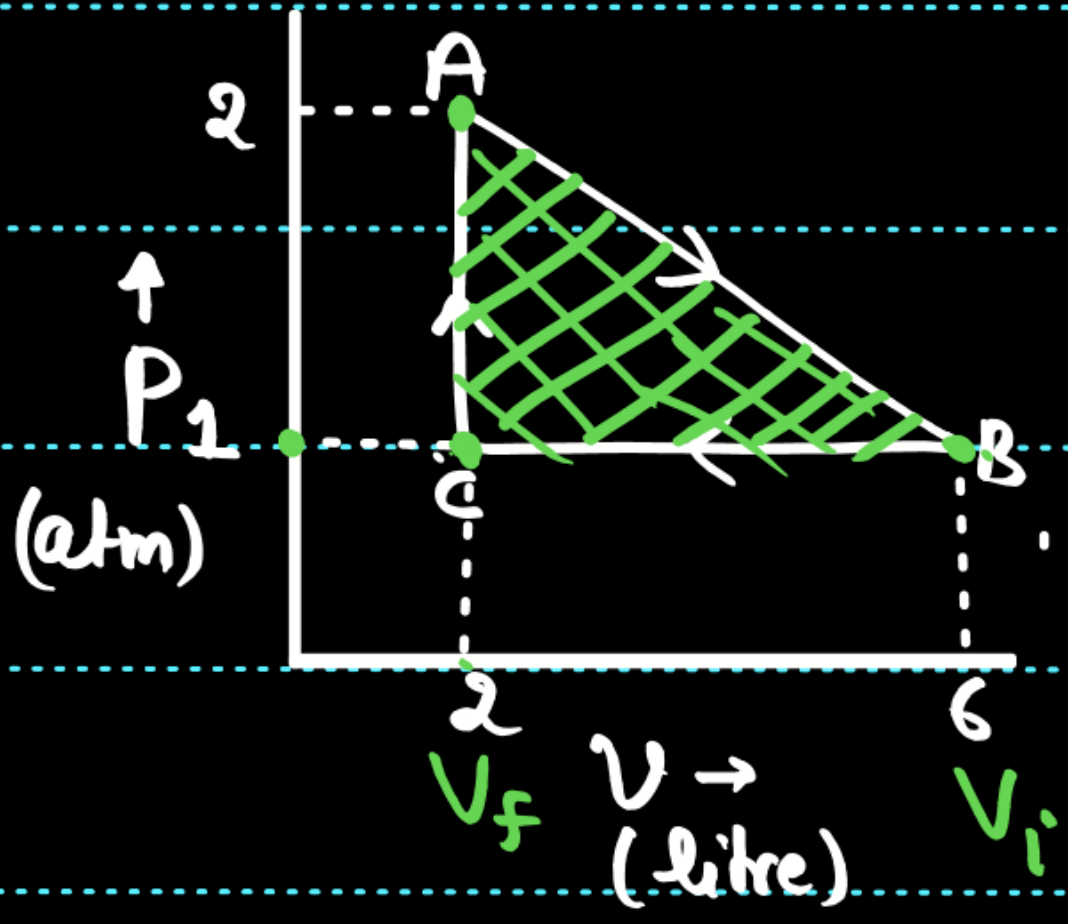
$W \rightarrow W_{iso} > W_{Adia}$

Q-1 → Calculate work done C → A

a) W = 0 b) W = −4 atm litre

c) W = +2 atm·litre d) NONE

C → A = isochoric → dV = 0, W = 0



Q-2 → Calculate work done in B → C

a) W = −4 atm litre b) W = +4 atm × litre c) W = +6 atm litre d) NONE

$B \to C$ = isobaric → $W = -P_{ext}dV = -P_{ext}(V_f - V_i) = -1\,atm\,(2-6)\,litre$

$= +4\,atm \times litre$

Q-3 → Calculate work done $A \to B \to C \to A$

$\frac{1}{2} \times \text{Base} \times \text{hieght}$

$= \frac{1}{2} \times (6-2)\,\text{litre} \times 1\,\text{atm}$

$= \frac{1}{2} \times 4 \times 1 = +2\,\text{atm} \times \text{litre}$

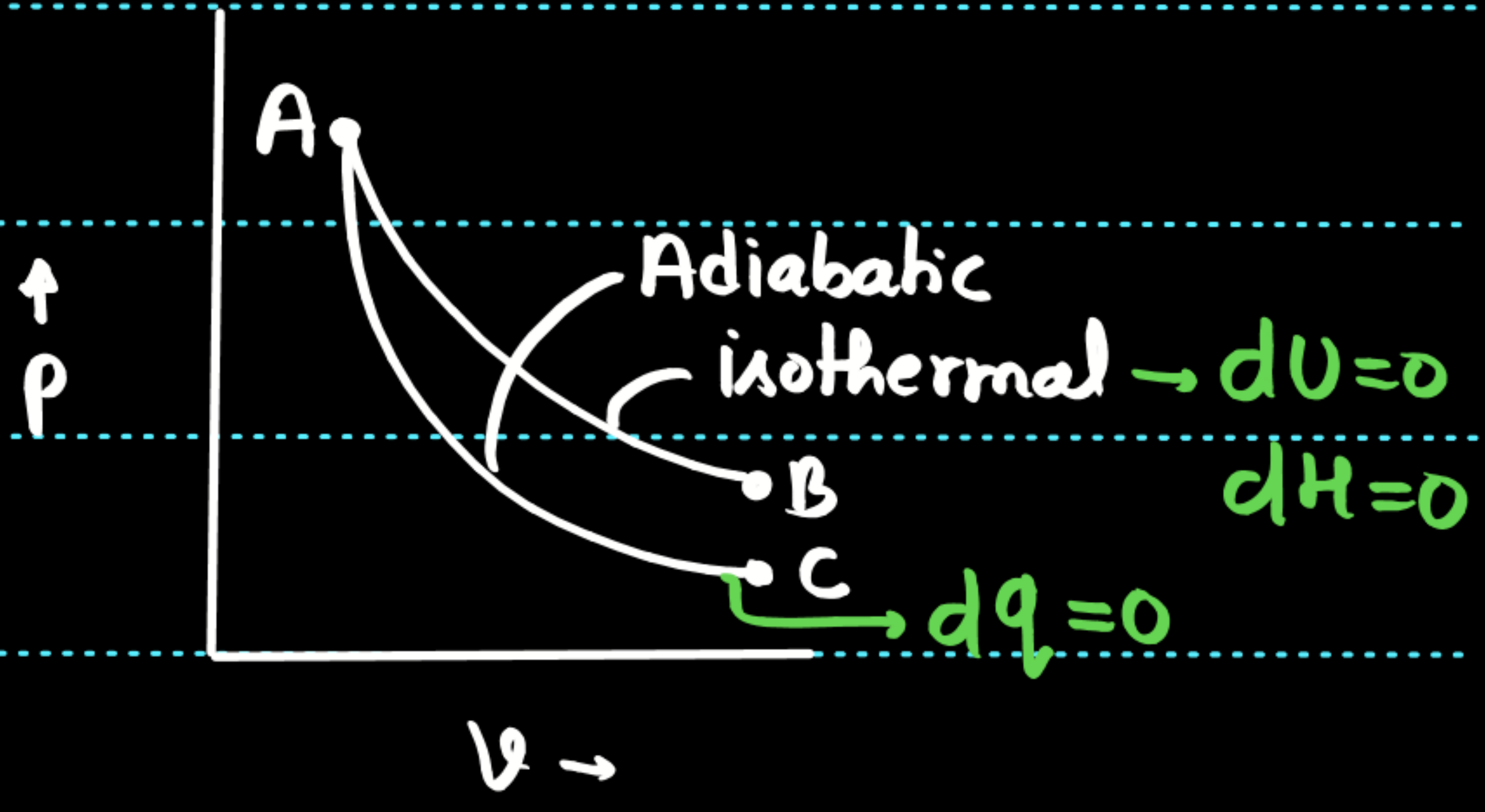
Q → Select correct option

a) $dU_{A\to B} = 0$

b) $dH_{A\to B} = 0$

c) $dq_{A\to C} = 0$

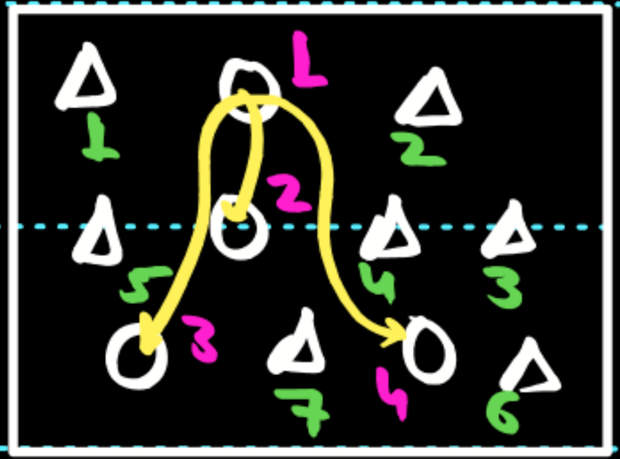
d) All Correct



Entropy

Measure randomness of process or sys

↳ disorderness



Δ → 1 ⇒ 6 location change kr sakta hai

O → 1 ⇒ 3 location change kr sakta hai

Entropy of Δ > Entropy of O

→ Extensive properties

→ Represent → S , change in entropy = ds = $S_f - S_i$

* State function

Example of entropy change

1) Entropy ∝ No. of molecules or atom → physical state same ho:

Q → a) 1 mole H_2 gas → Arrange → Entropy → b > a

b) 2 mole H_2 gas

2 → Entropy → gas > liquid > solid

Q → 1 mole each present in 3-different Container, a) H_2O (vapour)

a > b > c

b) H_2O (liquid)

c) H_2O (solid) → ice

~~a)~~ → a > b > c

c) a < b < c

b) → a = b = c

d) NONE

3) Mixing of 2-mixture or 2-sol^n = Entropy always increases.

Q → 1 mole H_2 gas mix with 2 mole N_2 gas, than entropy of sys is ____

a) increase

b) decrease

c) No change

d) Cannot say

4) **Entropy ∝ Atomicity** → (Mole of gas = Const, physical state = Const)

Q → a) 1 mole O_2 gas

b) 1 mole O_3 gas

Entropy order ⇒ b > a

5) **Entropy ∝ M·wt** → Atomicity = same
Physical state = same
Number = same

Q → 1 mole O_2 gas → (a)

1 mole N_2 gas → (b)

Entropy order = a > b

$O_2 \Rightarrow 32$

$N_2 = 28$

Q → select the correct option which have max. entropy if No. of mole of each option same

a) O_2 (g) //

b) He (g)

X c) Na(s)

X d) equal

MANTHAN NEET 2025

SANKALP NEET VEDANTU

CHEMISTRY

thermodynamics

Lecture-08

→ Sarvesh dixit csdofficial
→ SanKalp NEET Vedantu official
→ Test Chapterwise
→ planner → Kal milenga



Sarvesh Sir

~~2000Rs~~
↓
NYTS-2.0 = 1500Rs
↓
2000Rs
NCERT TEJAS-3BOOK = ~~1600Rs~~
↓
PCB

Qsd-1 select the correct option

for isothermal Reversible process

└ T = Const → $dU = 0$, $dH = 0$

a) $dU = 0$ ✓

b) $dH = 0$ ✓

$W = -nRT \ln \frac{P_i}{P_f}$

c) $W = -nRT \ln \frac{P_i}{P_f}$ ✓

d) All Correct ✓

Qsd-3 Select correct relation between C_p & C_v for 2 mole of ideal gas.

a) $C_p - C_v = R$

b) $2C_p = 2C_v + R$

c) $2C_p = 2C_v + 2R$ ✓

d) $2C_v = 2C_p + 2R$

$nC_p - nC_v = nR$ for n mole of ideal gas

$nC_p = nC_v + nR$

$n = 2$

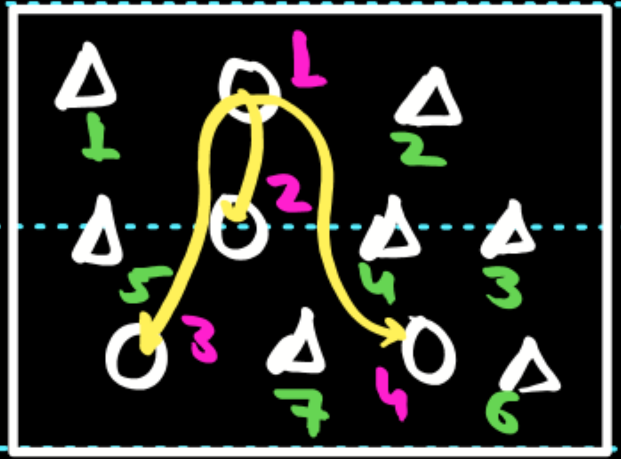
$2C_p = 2C_v + 2R$

$\frac{?}{?}$

13:3

Entropy

Measure randomness of process or sys
↳ disorderness



Δ → 1 ⇒ 6 location change kr sakta hai

O → 1 ⇒ 3 location change kr sakta hai

Entropy of Δ > Entropy of O

→ Extensive properties

→ Represent → S, change in entropy = $dS = S_f - S_i$

* State function

Example of entropy change

1) Entropy ∝ No. of molecules or atom → physical state same ho:

Q → a) 1 mole H_2 gas → Arrange → Entropy → b > a
b) 2 mole H_2 gas

2 → Entropy → gas > liquid > solid

Q → 1 mole each present in 3-different Container, a) H_2O (vapour)

a > b > c

b) H_2O (liquid)

c) H_2O (solid) → ice

~~a)~~ → a > b > c c) a < b < c

b) → a = b = c d) NONE

3) Mixing of 2-mixture or 2-sol^n = Entropy always increases.

Q → 1 mole H_2 gas mix with 2 mole N_2 gas, than entropy of sys is ____

a) increase b) decrease

c) No change d) Can not say

4) **Entropy ∝ Atomicity** → (Mole of gas = Const, physical state = Const)

Q → a) 1 mole O_2 gas

b) 1 mole O_3 gas

Entropy order ⇒ b > a

5) **Entropy ∝ M·wt** →
- Atomicity = same
- Physical state = same
- Number - same

Q → 1 mole O_2 gas → (a)

1 mole N_2 gas → (b)

Entropy order = a > b

O_2 ⇒ 32

N_2 = 28

C_{SD} – Entropy = measure randomness of process or sys

1 → Represent → S

2 - change in entropy = dS

3. Extensive prop^r

4. State function

5. Entropy ∝ No. of mole (Phy. State = same)

6. Entropy = Gas > Liq. > Solid

7. Entropy ∝ Atomicity (Mole = Const, Phy. S = same)

8. Entropy ∝ M.wt → Atomicity, Phy. State, Number } same

9. Entropy ∝ temperature

10. Entropy ⇒ Alloy > pure form

11. Entropy → Mixing → increases

12. Vapourization $\Rightarrow$ liquid $\longrightarrow$ vapour $\rightarrow$ $\Delta S = +ve$ $\rightarrow$ $S_{gas} > S_{liq.}$

13. Freezing = liquid $\longrightarrow$ solid $\rightarrow$ $\Delta S = -ve$ $\rightarrow$ $S_{liq} > S_{solid}$

14. Sublimation = Solid $\rightarrow$ Gas $\rightarrow$ $\uparrow$ $\rightarrow$ $\Delta S = +ve$ increases

15. Adsorption =  $\rightarrow$ $\Delta S = -ve$ $\downarrow$ decrease

16. Corrosion $\rightarrow$ Resting of Iron =  Fe + Atomsphere $\rightarrow$ $Fe_2O_3 \cdot xH_2O$

↳ $\Delta S = +ve$, $\uparrow$ increase, Rust

17 $\rightarrow$ Ionic comp dissolve in H_2O $\Rightarrow$ $\Delta S = +ve$ $\uparrow$ increases

18 $\rightarrow$ boiling of egg $\rightarrow$ Entropy $\rightarrow$ $\uparrow$ increases (Reason $\rightarrow$ breaking of Protein bond)

CSD 19. $ds = \frac{q_{rev}}{T}$

Where → q_{rev} = Heat at Reversible (Equilibrium) Process, T = temperature of sys.

20. Unit of ds = $\frac{Joule}{K}$ or Joule K^{-1}

21. Entropy of Adiabatic Rev. process

$ds = 0$ → Reason → $q_{rev} = 0$

22. Entropy change of cyclic Rev. process → $ds = 0$ → State function

23. Entropy change in isothermal Rev. process ⇒ $ds = nR \ln \frac{V_f}{V_i}$

$ds = nR \ln \frac{P_i}{P_f}$

24. Entropy change of Isochoric process → $ds = nC_v \ln \frac{T_f}{T_i}$

25. Entropy Change of Isobaric Rev. Process → $ds = nC_p \ln \frac{T_f}{T_i}$

26. Entropy change in chemical Reaction

$\Delta S_{rxn} = S_{prd} - S_{Reactant}$

Ex → $n_1 A \longrightarrow n_2 B$

$\Delta S_{rxn} = (n_2 \times S_B) - (n_1 \times S_A)$

→ $\Delta S_{rxn} \propto \Delta n_g$ → same sign
***

27. Entropy change in phase transfer

All phase transfer pro. = Occurs in Equilbm.

$q_{rev} = \Delta H$

Vapourization liq → vap

$dS = \frac{\Delta H_{vap}}{T_{b.p.}}$

Fusion → $dS = \frac{\Delta H_{fus}}{T_{m.p.}}$

Solid → liq

Sublimation → $dS = \frac{\Delta H_{sub}}{T}$

Solid ⟶ Gas

$(dS)_{sub} = (dS)_{vap} + (dS)_{fus}$

Q → a) 1 mole He gas at 300K

b) 1 mole He gas at 400K

Entropy → b > a

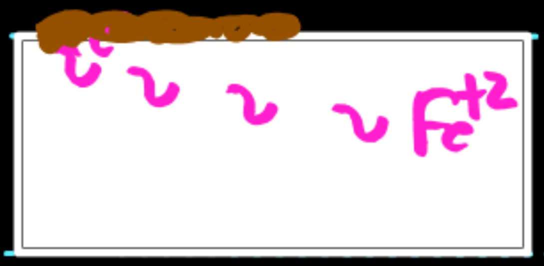
Q → Arrange entropy

a) Copper pyride

→ a > b

b) Pure copper solid

→ $CuFeS_2$ → Copper pyride - ore of Cu



Si = Solid

$Fe \longrightarrow Fe^{+2} + 2e^-$

$O_2 + H_2O + Fe^{+2} \rightarrow Fe_2O_3 \cdot xH_2O$

Entropy change in different process

a) Isothermal Reversible process

$T = \text{Const} \rightarrow W = -q$

$$dS = \frac{q_{rev}}{T} = -\frac{W_{Rev}}{T}$$

$$dS = -\frac{\left(-nRT \ln \frac{V_f}{V_i}\right)}{T}$$

$$dS = nR \ln \frac{V_f}{V_i} = nR \ln \frac{P_i}{P_f}$$

b) Adiabatic Reversible process

$q_{rev} = 0$, $dS = 0$

c) Cyclic Reversible process

Entropy = state funct^n

$$dS = 0$$

$$ds = \frac{q_{rev}}{T}$$

isochoric = V = Const

$$ds = \frac{(q_{rev})_V}{T}$$

$$\int ds = \frac{dU}{T} = \int \frac{nC_v dT}{T}$$

$$ds = nC_v \int_{T_i}^{T_f} \frac{1}{T} dT = nC_v (\ln T)_{T_i}^{T_f}$$

Q → $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$

a) $\Delta S = -ve$ b) $\Delta S = +ve$ ✓

c) $\Delta S = 0$ d) Can not say

$$\Delta n_g = (n_g)_P - (n_g)_R$$

$$= 1 - 0 = 1$$

$\Delta S = +ve$

Vapourization

liq $\rightleftharpoons$ vapour, $\Delta H_{vap} = +ve$

$q_{rev} = \Delta H_{vap}$

$$dS = \frac{q_{rev}}{T} \rightarrow \frac{\Delta H_{vap}}{T_{b.p.}}$$

Fusion — solid $\rightleftharpoons$ liquid, $(q_{rev})_p = +ve \Rightarrow \Delta H_{fus} = +ve$

$$dS = \frac{\Delta H_{fus}}{T_{m.p.}}$$

Entropy change of universe

$$(dS)_{uni} = (dS)_{sys} + (dS)_{surr^n}$$

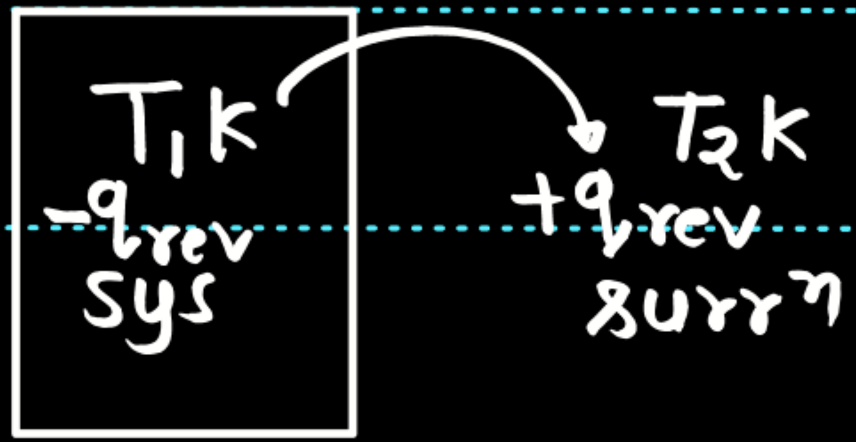
a) isolated cyclic Reversible process

$$(dS)_{sys} = 0$$

$$(dS)_{surr^n} = 0$$

$$(dS)_{uni} = 0 + 0 = 0$$

b) noncyclic Rev. process



$T_1 K > T_2 K$

$$(dS)_{sys} = \frac{-q_{rev}}{T_1}, \quad (dS)_{surr} = \frac{+q_{rev}}{T_2}$$

$$(dS)_{uni} = \frac{-q_{rev}}{T_1} + \frac{q_{rev}}{T_2}$$

2^{nd} law of thermodynamics

$$(ds)_{univ} = \underset{+ve}{q_{rev.}} \underset{+ve}{\left(\frac{1}{T_2} - \frac{1}{T_1} \right)}$$

$T_1 > T_2$ or $\frac{1}{T_1} < \frac{1}{T_2}$

$(ds)_{univ} = +ve$ ↑ increase

$(ds)_{univ} > 0$

Entropy of universe increases in noncyclic reversible process

$(ds)_{univ} = +ve$, $(ds)_{uni} > 0$

Q39. What is the entropy change (in JK^{-1} mol^{-1}) when one mole of ice is converted into water at 0°C? (The enthalpy change for the conversion of ice to liquid water is 6.0 kJ mol^{-1} at 0°C) [CBSE AIPMT 2003]

(a) 2.198 JK^{-1} mol^{-1}
(b) 21.98 JK^{-1} mol^{-1}
(c) 20.13 JK^{-1} mol^{-1}
(d) 2.013 JK^{-1} mol^{-1}

$$ds = \frac{dH_{fus}}{T_{mp}}$$

$$= \frac{6000 J/mole}{273}$$

$$= 21.978 J\ mole^{-1}, K^{-1}$$

Q51. The entropy change in the fusion of one mole of a solid melting at 27°C (latent heat of fusion is 2930 J mol^{-1}) is

[CBSE AIPMT 2000]

(a) 9.77 JK^{-1} mol^{-1}

(b) 10.73 JK^{-1} mol^{-1}

(c) 2930 JK^{-1} mol^{-1}

(d) 108.5 JK^{-1} mol^{-1}

$$dS = \frac{\Delta H_{fus}}{T_{mp}} = \frac{2930\ J/mole}{300}$$

$$= \frac{29.3}{3} \frac{J}{mole \times K}$$

$$= 9.77\ J\ mole^{-1}, K^{-1}$$

Q16. If the enthalpy change for the transition of liquid water to steam is 30 kJ mol^{-1} at 27°C, the entropy change for the process would be **[CBSE AIPMT 2011]**

(a) 1.0 J mol^{-1} K^{-1}

(b) 0.1 J mol^{-1} K^{-1}

(c) 100 J mol^{-1} K^{-1}

(d) 10 J mol^{-1} K^{-1}

$\Delta H_{vap} = \frac{30 kJ}{mole}$

$T = 27 + 273 = 300 K$

$dS = \frac{\Delta H_{vap}}{T} = \frac{30 \times 1000}{300} J/mole$

$= 100 J \, mole^{-1} K^{-1}$

Q45. Unit of entropy is [CBSE AIPMT 2002]

(a) $JK^{-1} mol^{-1}$

(b) $J mol^{-1}$

(c) $J^{-1} K^{-1} mol^{-1}$

(d) $JK mol^{-1}$

$$ds = \frac{q_{rev}}{T} = \frac{J}{K} = JK^{-1}$$

ds per mole = molar entropy change $= \frac{JK^{-1}}{mole} =$ Joule K^{-1}, $mole^{-1}$

Q14. The enthalpy of fusion of water is 1.435 kcal/mol. The molar entropy change for the melting of ice at 0°C is

[CBSE AIPMT 2012]

(a) 10.52 cal/mol K
(b) 21.04 cal/mol K
(c) 5.260 cal/mol K
(d) 0.526 cal/mol K

ΔH_{fus}

$$dS = \frac{\Delta H_{fus}}{T_{mp}}$$

$$= \frac{1.435\ Kcal/mole}{273} = \frac{1435\ Cal/mole}{273}$$

$$\Rightarrow dS = 5.25 \frac{Cal}{K \times mole}$$

today ⇒ 7pm → live U-tube

MANTHAN NEET 2025

sarveshdixitcsd official → telegram

CHEMISTRY

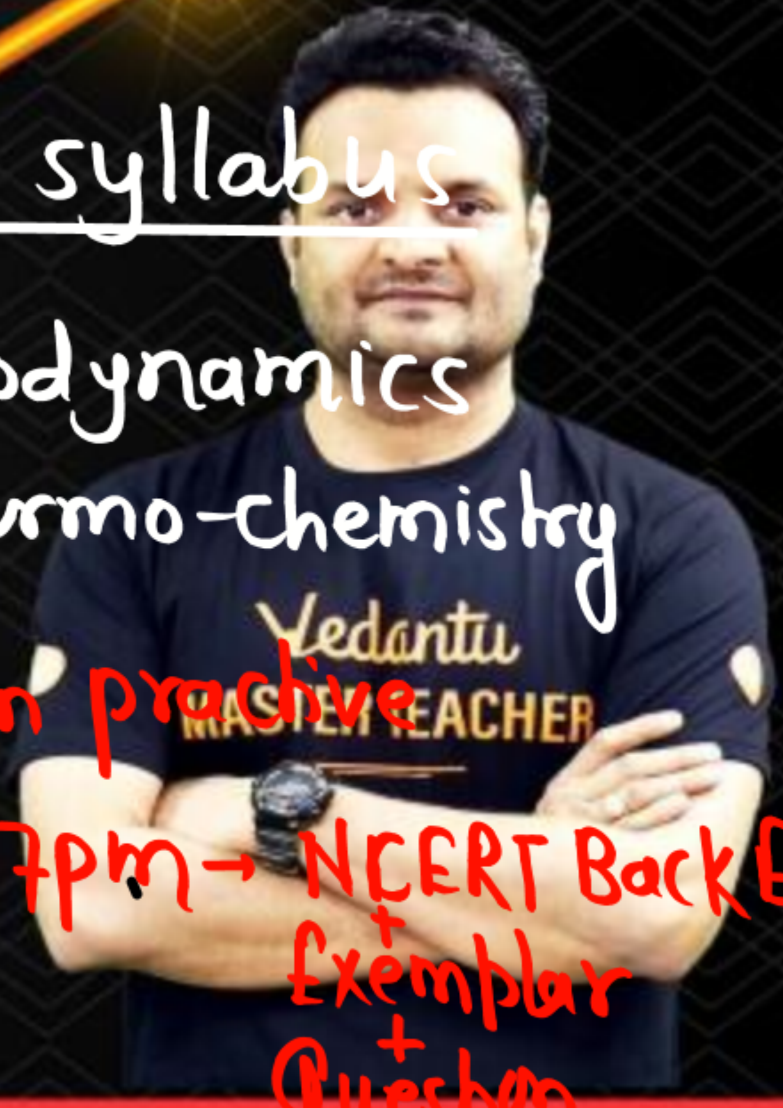
thermodynamics

Lecture-09

Test Ka syllabus

Thermodynamics
& thermo-chemistry
↓
Question practice

Live → 7pm → NCERT Back Exercise
+
Exemplar
+
Question



Sarvesh Sir

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Qsd-1 In which process, entropy of system increases

a) dissociation of $CaCO_3$ → $CaO + CO_2(g)$ → $\Delta n_g = 1 - 0 = 1$

b) vapourization of water ⇒ liq → vapour

c) $Na_2SO_4(s)$ dissolve in water $Na_2SO_4(s) \rightarrow 2Na^+(aq) + SO_4^{-2}(aq)$

✓ d) All

Qsd-2 what amount of entropy change, when 2 mole of gas expanded isothermally Reversibly 10L to 20L at 300K temp.

× a) $\frac{6R}{10}$

× b) 4R

× c) 6R

~~d)~~ NONE

$\frac{?}{2}$

$ds = nR \ln \frac{V_F}{V_i} = 2.3032\, nR \log \frac{V_F}{V_i}$

$ds = 2.3032 \times 2 \times R \log \frac{20}{10}$

$= 2.3032 \times 2 \times R \times 0.3$

$= 2.3032 \times 0.6R$

Gibbs free energy

spontaneous → process occurs without any external agent

1) $\Delta S_{uni} > 0$, +ve → spontaneous

2) ΔH → minimum

* Gibbs free energy measure spontainty of process

* Represent → G

* Change in Gibbs free energy = dG or ΔG

* Extensive propr, state function

$G = H - TS$

$$dG = dH - TdS$$ → at Const T & P

dG → Gibbs free energy change

dH = enthalpy change

dS = entropy change

Case-1 $\Delta G = -ve$ → Spontaneous (L → R)

Case-2 $\Delta G = +ve$ → nonspontaneous (L → R)

Case-3 → $\Delta G = 0$ → process at Equilibrium (Equal tendency to move both direction)

Note But opposite process spontaneous (R → L)

$dG = dH - TdS$ $dG = -dH - TdS$

1) $dH = -ve$, $dS = +ve$ → always $dG = -ve$ → any value of temperature

2) $dH = -ve$, $dS = -ve$ → $dG = -dH + TdS$

a) $dH > TdS$ → $dG = -ve$ → temp → low (spontaneous)

b) $dH < TdS$ → $dG = +ve$ → nonspontaneous (high temp.)

3) $dH = +ve$, $dS = +ve$ ⇒ $dG = dH - TdS$

a) $dH < TdS$ → $\Delta G = -ve$ → high temp → spontaneous

b) $dH > TdS$ → $\Delta G = +ve$ → low temp → nonspontaneous

4) $dH = +ve$, $dS = -ve$ $\rightarrow$ $dG = dH + TdS = +ve$ $\rightarrow$ all value of temp $\rightarrow$ nonspontaneous

Q $\rightarrow$ select the Correct Condition of spontaneous process in all value of temp.

✗ a) $\Delta H = +ve$, $dS = -ve$ $\rightarrow$ $dG = +dH + TdS$

b) $dH = +ve$ $dS = +ve$ $\rightarrow$ $dG = +dH - TdS$ $\rightarrow$ $dH < TdS$

~~c)~~ $dH = -ve$, $dS = +ve$ $\rightarrow$ $dG = -dH - TdS$

d) NONE

Spontaneous temperature and Equilibrium temperature

$\Delta G = dH - TdS$

at Equilibrium → $\Delta G = 0$

$0 = dH - TdS$

$dH = TdS$

$T = \frac{dH}{dS} \Rightarrow$ $\boxed{T_{Eq} = \frac{dH}{dS}}$

Spontaneous → $\Delta G = -ve$

$-ve = dH - TdS$

$TdS > dH$

$T > \frac{dH}{dS}$

$\boxed{T_{spon} > \frac{dH}{dS}}$

$T_{spon} > T_{Eq}$

ΔG in term of dU

$$dG = dH - TdS$$

$$dG = dU + PdV - TdS \quad (\because dH = dU + PdV)$$

$$dG = dU + \Delta n_g RT - TdS \quad (\because dH = dU + \Delta n_g RT)$$

Relation between ΔG° and Keq (Equilibrium Const)

$$\Delta G^\circ = -nR\log K_{eq} = -2.3032\,nR\log K_{eq}$$

Csd

→ Standard Gibbs free energy of natural form (most stable state) of element is suppose to ZERO, ($\Delta G^\circ = 0$), $\Delta G \neq 0$

$Na(s) \rightarrow \Delta G^\circ = 0$

$Na(g) \rightarrow \Delta G^\circ \neq 0$

$H_2(g) \rightarrow \Delta G^\circ = 0$

$H_2(l) \rightarrow \Delta G^\circ \neq 0$

$I_2(s) \rightarrow \Delta G^\circ = 0$

$Br_2(l) \rightarrow \Delta G^\circ = 0$

$Cl_2(g) \rightarrow \Delta G^\circ = 0$

C(graphite) $\rightarrow \Delta G^\circ = 0$

C(daimond) $\rightarrow \Delta G^\circ \neq 0$

S(Rhombic) $\rightarrow \Delta G^\circ = 0$

Q → select the Correct option in which, $\Delta G^\circ \neq 0$

a) $U_2(g) \rightarrow \Delta G^\circ = 0$

b) $Br_2(g) \rightarrow \Delta G^\circ \neq 0$

c) $F_2(g) \rightarrow \Delta G^\circ = 0$

d) $O_2(g) \rightarrow \Delta G^\circ = 0$

Gibbs free energy of chemical Rxn

$n_1 A + n_2 B \longrightarrow n_3 C + n_4 D$ (Balance)

$$\Delta G^0_{rxn} = \Delta G^0_{prd} - \Delta G^0_{Reactant}$$

$$= (n_3 \times \Delta G^0_C + n_4 \Delta G^0_D) - (n_1 \times \Delta G^0_A + n_2 \Delta G^0_B)$$

13:3

Q → $2NO \rightleftharpoons N_2O_2$

ΔG° of NO and N_2O_2 is +20 KJ/mole & −30 KJ/mole respectively, Calculate standard Gibbs free change of rxn

a) −70 KJ

b) +70 KJ

c) −10 KJ

d) +10 KJ

$\Delta G^\circ_{rxn} = \Delta G^\circ_{prd} - \Delta G^\circ_{React}$

$= 1 \times -30 KJ - 2 \times 20 KJ$

$= -30 - 40 = -70 KJ$

Q4. The correct thermodynamic conditions for the spontaneous reaction at all temperature is

[NEET 2016, Phase-I]

(a) $\otimes H > 0$ and $\otimes S < 0$

(b) $\otimes H < 0$ and $\otimes S > 0$

(c) $\otimes H < 0$ and $\otimes S < 0$

(d) $\otimes H < 0$ and $\otimes S = 0$

dH = -ve , dS = +ve

dG = -dH - TdS

Q1. For a given reaction, ⊗H= 35.5 kJ mol^{-1} and ⊗S= 83.6 JK^{-1} mol^{-1}. The reaction is spontaneous at: (Assume that ⊗S and⊗H do not vary with temperature)

[NEET 2017]

(a) T < 425 K → ×

(b) T > 425K ✓

(c) all temperatures ×

(d) T > 298 K ×

300
350
450
500

$T_{spon} > \frac{dH}{dS}$

$T_{spon} > \frac{35.5 \times 1000\ J}{83.6\ J}$

$T_{spon} > 424.6\ K$

Q27. The enthalpy and entropy change for the reaction, $Br_2(l) + Cl_2(g) \longrightarrow 2BrCl(g)$ are 30 kJ mol^{-1} and 105 JK^{-1} mol^{-1} respectively. The temperature at which the reaction will be in equilibrium is

[CBSE AIPMT 2006]

(a) 285.7 K
(b) 273 K
(c) 450 K
(d) 300 K

$$T_{Eq} = \frac{dH}{dS} = \frac{30000\,J}{105\,J} = 285.7\,K$$

Q10. For the reaction, $X_2O_4(l) \longrightarrow 2XO(g)$, $2-0=2$

$\Delta U = 2.1$ kcal, $\Delta S = 20$ cal K^{-1} at 300K. Hence, ΔG is

[CBSE AIPMT 2014]

(a) 2.7 kcal
(b) –2.7 kcal
(c) 9.3 kcal
(d) –9.3 kcal

$$\Delta G = \Delta U + \Delta n_g RT - T\Delta S$$

$$= 2.1\ \text{Kcal} + 2 \times 2 \times 10^{-3}\ \text{Kcal} \times 300 - 300 \times 20 \times 10^{-3}\ \text{Kcal}$$

$$= 2.1 + (4-20) \times 300 \times 10^{-3}$$

$$= 2.1 - 16 \times 300 \times 10^{-3}$$

$$= 2.1 - 4800 \times 10^{-3} = 2.1 - 4.8$$

$$= -2.7\ \text{Kcal}$$

$$\begin{array}{r} 0.020 \\ 0.004 \\ \hline 0.016 \end{array}$$

3rd Law of thermodynamics

Crystalline solid → $\Delta S = 0$ at 0K temperature

Complete thermodynamic

Live → 7pm → You tube → Sankalp neet vedantu channel

Quest^n → NCERT + Exemplar + PYQ + Quest^n (FYQ)

Q35. Standard enthalpy and standard entropy changes for the oxidation of ammonia at 298 K are –382.64 kJ mol^{-1} and –145.6 JK^{-1}, respectively. Standard Gibbs energy change for the same reaction at 298 K is [CBSE AIPMT 2004]

(a) –221.1 kJ mol^{-1}
(b) –339.3 kJ mol^{-1}
(c) –439.3 kJ mol^{-1}
(d) –523.2 kJ mol^{-1}

Q22. For the gas phase reaction,

$$PCl_5(g) \; ▯▯▯ \; PCl_3(g) + Cl_2(g),$$

which of the following conditions are correct?

[CBSE AIPMT 2008]

(a) $\otimes H = 0$ and $\otimes S < 0$

(b) $\otimes H > 0$ and $\otimes S > 0$

(c) $\otimes H < 0$ and $\otimes S < 0$

(d) $\otimes H > 0$ and $\otimes S < 0$

Q32. A reaction occurs spontaneously if [CBSE AIPMT 2005]

(a) $T\otimes S < \otimes H$ and both $\otimes H$ and $\otimes S$ are +ve

(b) $T\otimes S > \otimes H$ and both $\otimes H$ and $\otimes S$ are +ve

(c) $T\otimes S = \otimes H$ and both $\otimes H$ and Ä are +ve

(d) $T\otimes S > \otimes H$ and $\otimes H$ is +ve and $\otimes S$ is –ve

Q29. Identify the correct statement for change of Gibbs free energy for a system ($\otimes G_{system}$) at constant temperature and pressure. **[CBSE AIPMT 2006]**

(a) If > 0, the process is spontaneous

(b) If $\otimes G_{system} = 0$, the system has attained equilibrium

(c) If $\otimes G_{system} = 0$, the system is still moving in a particular direction $\otimes G_{system}$

(d) If < 0, the process is not spontaneous

$\otimes G_{system}$

THANK YOU

All the Best!! 👍

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CHEMISTRY

thermodynamics

Lecture-10

qsd = ?



Sarvesh Sir

Qsd-1 Equilibrium temp. of reaction is 247K

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

than select correct Option

$T_{Eq} = \frac{\Delta H}{\Delta S}$

a) ✗ Rxn is spontaneous at 247K

b) ✓ Rxn is spontaneous greater than 247K

$T_{spon} > \frac{\Delta H}{\Delta S}$

c) ✗ Rxn is spontaneous less than 247K

d) all incorrect

$T_{spon} > T_{Eq.} \Rightarrow T_{spon} > 247K$

Qsd-2 Gibbs free energy is a

a) Extensive prop^r

b) State function

c) $\Delta G^\circ = 0$ for natural form of elements

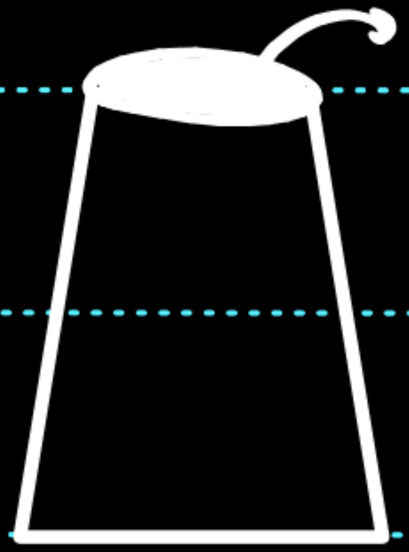
d) All Correct

$\frac{?}{2}$

THERMO-CHEMISTRY

Heat of Reaction or Enthalpy of Reaction

→ Heat at Constant pressure = Enthalpy change ($dH = q_p$)



generally open vessel → test tube,

$P = Const \rightarrow P = P_{atm} = 1\,atm \simeq 1\,bar$

release | gain energy = $q_v = dH$ or ΔH

$\Delta H = -ve$ (exothermic → Heat release)

$\Delta H = +ve$ (endothermic → Heat gain)

→ ΔH = Extensive prop^r

→ State function.

total amount of Heat or energy exchange (exo or endo.) in any chemical reaction or physical Conversion is Known Heat of Reaction -300KJ

Ex→

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$, $\Delta H = -300 KJ$

$PCl_3 + Cl_2 \rightleftharpoons PCl_5$, $\Delta H = ?$

a) 300KJ b) -300KJ c) 150KJ d) NONE

Classification of Heat of rxn in basis of Reaction nature

Heat of Reactⁿ →

- Acid-base rxn = Heat of neutralisation
- Combustion = Heat of Combustion = ΔH_c
- Formation = Heat of formation = ΔH_f
- Vapourization = Heat of Vapourization = ΔH_{vap}
- Bond break = Bond dissociation energy or Bond enthalpy
- . . .
- . . .

CSD = definition of process
↓
formula, Concept

Heat of formation or Enthalpy of formation

total amount of Heat exchange (exo or endo) in formation of 1 mole of molecule by their most stable state of elements (natural form of elements)

$C(s) + O_2(g) \longrightarrow CO_2(g)$

$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O(l)$

(X) → $H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$

$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \longrightarrow NH_3(g)$

Q → select correct rxn for heat of formation of $SO_3(g)$

a) $SO_2(g) + \frac{1}{2}O_2(g) \longrightarrow SO_3(g)$

~~b)~~ $S(s) + \frac{3}{2}O_2(g) \longrightarrow SO_3(g)$ ✓

Standard Heat of formation

→ Formation → fixed temp & pressure

Standard Condition →	$T = 298K$ or $25°C$
	$P = 1 atm \simeq 1 bar$

→ Represent → ΔH_f° , total amount of Heat exchange in formation of 1 mole molecule by their most stable state (natural form of elements) at standard Condition (at 298K temp & 1 bar press)

Q → $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

total amount of heat release in formation of NH_3 is -400 KJ

Calculate heat of formation of NH_3

a) -400 KJ/mole

b) $+400$ KJ/mole

c) -200 KJ/mole

d) $+100$ KJ/mole

$\Delta H_f^0 = \frac{-400\text{ KJ}}{2} = -200$ KJ/mole

Q → $C(grp) + O_2(g) \longrightarrow CO_2(g)$

in formation of 11 gram $CO_2(g)$, heat release −50 KJ

Calculate H.O.F (ΔH_f°) of CO_2 gas

↓ 1 mole

a) −50 KJ/mole

b) −200 KJ/mole ✓

c) $-\frac{50}{4}$ KJ/mole

d) NONE

$\frac{11}{44} = \frac{1}{4}$ mole $= -50$ KJ

1 mole $= -\frac{50}{\frac{1}{4}} = -50 \times 4 = -200$ KJ/mole

Q → $2S(s) + 3O_2(g) \longrightarrow 2SO_3(g)$

Calculate Heat of rxn in above given rxn.

If ΔH_f° of $SO_3(g)$ is -150 KJ/mole

a) +150 KJ

b) −150 KJ   2 mole = −150 × 2 = −300 KJ

c) −300 KJ

d) −270 KJ

Heat of Reaction in term of Heat of formation

$$n_1 A(s) + n_2 B(s) \longrightarrow A_{n_1}B_{n_2}(s)$$

$$\Delta H^\circ_{Rxn} = (\Delta H^\circ_f)_{product} - (\Delta H^\circ_f)_{Reactant}$$

$$1 \times (\Delta H^\circ_f)_{A_{n_1}B_{n_2}} - \left[n_1 \times (\Delta H^\circ_f)_A + n_2 \times (\Delta H^\circ_f)_B\right]$$

Note ⇒ $\Delta H^\circ_f = 0$ → for most stable state of elements (natural form of element)

$\Delta H_f \neq 0$

$H_2(g) \rightarrow \Delta H_f^\circ = 0$	C (graphite) $\rightarrow \Delta H_f^\circ = 0$
$H_2(l) \rightarrow \Delta H_f^\circ \neq 0$	C (diamond) $\rightarrow \Delta H_f^\circ \neq 0$
$Br_2(l) \rightarrow \Delta H_f^\circ = 0$	S (Rhombic) $\rightarrow \Delta H_f^\circ = 0$
$Br_2(g) \rightarrow \Delta H_f^\circ \neq 0$	P (White) $\rightarrow \Delta H_f^\circ = 0$
$I_2(s) \rightarrow \Delta H_f^\circ = 0$	
$I_2(g) \rightarrow \Delta H_f^\circ \neq 0$	
$Zn(s) \rightarrow \Delta H_f^\circ = 0$	

Q $C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(l)$, $\Delta H = ?$

$\Delta H_f^\circ \rightarrow C_2H_4 = +50\,kJ/mole$

$CO_2 = +80\,kJ/mole$

$H_2O(l) = +70\,kJ/mole$

Sol^n = $\Delta H^\circ_{rxn} = (\Delta H_f^\circ)_P - (\Delta H_f^\circ)_R = \left[2\times(\Delta H_f^\circ)_{CO_2} + 2\times(\Delta H_f^\circ)_{H_2O} - 1\times(\Delta H_f^\circ)_{C_2H_4} - 3\times(\Delta H_f^\circ)_{O_2}\right]$

$\Rightarrow 2\times80 + 2\times70 - 1\times50 - 3\times0$

$= 160 + 140 - 50 \Rightarrow 250\,kJ$

Q → $C_2H_4 + 3O_2 \longrightarrow 2CO_2(g) + 2H_2O(l)$, $\Delta H = ?$

given → $2C(s) + 2H_2 \longrightarrow C_2H_4$, $\Delta H = +50KJ$

$C(s) + O_2 \longrightarrow CO_2(g)$ $\Delta H = +80KJ$

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l)$, $\Delta H = +70KJ$

$C_2H_4 \longrightarrow \cancel{2C} + \cancel{2H_2} \rightarrow \Delta H = -50KJ$

$\cancel{2C} + 2O_2 \longrightarrow 2CO_2(g) \rightarrow \Delta H = +80\times2KJ$

$\cancel{2H_2} + O_2 \longrightarrow 2H_2O(l) \rightarrow \Delta H = 70\times2KJ$

$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O \Rightarrow -50 + 160 + 140 = \underline{+250KJ}$

Q → $2C_6H_6 + 15O_2 \rightarrow 12CO_2 + 6H_2O$, $\Delta H = ?$

$6C + 3H_2 \rightarrow C_6H_6$, $\Delta H = -100\,KJ$

$C(s) + O_2 \rightarrow CO_2$, $\Delta H = +50\,KJ$ — ①

$H_2(g) + \frac{1}{2}O_2 \rightarrow H_2O$, $\Delta H = +70\,KJ$ — ②

Solⁿ = $2C_6H_6 \rightarrow 12C + 6H_2$, $\Delta H = +100 \times 2\,KJ$ — ③

① × 12 + ② × 6 + ③

$\cancel{12C} + 12O_2 + \cancel{6H_2} + 3O_2 + 2C_6H_6 \rightarrow 12CO_2 + 6H_2O + \cancel{12C} + \cancel{6H_2}$

$2C_6H_6 + 15O_2 \rightarrow 12CO_2 + 6H_2O$, $+1220\,KJ$

$\Delta H = 50 \times 12 + 6 \times 70 + 200$

$= 600 + 420 + 200$

$= 1220\,KJ$

$$x + 2y = 7 \quad \text{— (1)}$$

$$2x + 2z = 2y + 9 \quad \text{— (2)}$$

$$3x + 2z = ?$$

$$(1) + (2) \Rightarrow 3x + 2z + \cancel{2y} = \cancel{2y} + 7 + 9$$

$$3x + 2z = \boxed{16}$$

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CHEMISTRY

thermodynamics

Lecture-11

Qsd →



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Qsd-1 Which comp, Heat of formation does not equal to zero at standard condition.

(a) $H_2(g)$ → ✗

(b) $O_2(g)$ → ✗

(c) $Zn(s)$ → ✗

(d) $Br_2(g)$ → $\Delta H_f^\circ \neq 0$ → $Br_2(l)$ → $\Delta H_f^\circ = 0$

Qsd-2

Q57. Given that,

$C(s) + O_2(g) \longrightarrow CO_2(g)$, $\Delta H^o = -x$ kJ

$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$, $\ddot{A}H^o = -y$ kJ

The enthalpy of formation of carbon monoxide will be

$C(s) + \frac{1}{2}O_{2(g)} \longrightarrow CO(g)$ [CBSE AIPMT 1997]

(a) $y - 2x$

(b) $2x - y$

(c) ✓ $\frac{y-2x}{2}$

(d) $\frac{2x-y}{2}$

$2CO_2 \longrightarrow 2CO + O_2$, $\Delta H = +y$ KJ

$CO_2 \longrightarrow CO + \frac{1}{2}O_2$, $\Delta H = +\frac{y}{2}$ KJ —— (i)

$C(s) + O_2 \longrightarrow CO_2(g)$, $\Delta H = -x$ KJ —— (ii)

(1)+(2) $C(s) + O_2 \rightarrow CO + \frac{1}{2}O_2$, $\Delta H = \frac{y}{2} - x$

$C(s) + \frac{1}{2}O_2 \rightarrow CO$, $\Delta H = \frac{y-2x}{2}$

$\frac{?}{2}$

Heat of Combustion

Combustion or burning or electric spark, Complete oxidation = Reaction with O_2 gas

$C \longrightarrow CO_2(g)$

$H \longrightarrow H_2O(l)$

$N \longrightarrow NO_2, NO$

$S \longrightarrow SO_2$

$P \longrightarrow P_4O_{10}$

total amount heat release (exo-) in Combustion of 1 mole of Compound

$\rightarrow \Delta H_c$

Standard Heat of Combustion = ΔH_c°

$$C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2(g) + 3H_2O(l)$$

24+6=30

Q → 10 gram ethane Combustion occurs and release -120 KJ heat. Calculate H.O.C. of ethane

a) -360 KJ/mole ✓

b) -40 KJ/mole

c) +360 KJ/mole

d) -240 KJ/mole

$$10\text{ gram} = \frac{10}{30} = \frac{1}{3}\text{ mole}$$

$$\frac{1}{3}\text{ mole} = -120\text{ KJ}$$

$$1\text{ mole} = \frac{-120}{\frac{1}{3}} = -120 \times 3 = -360\text{ KJ/mole}$$

CSD

$$\Delta H^\circ_{Rxn} = (\Delta H^\circ_c)_{Reactant} - (\Delta H^\circ_c)_{product}$$

$$\Delta H^\circ_{Rxn} = (\Delta H^\circ_f)_{prd} - (\Delta H^\circ_f)_{Reactant}$$

Q →  , $\Delta H^\circ = ?$

given → ΔH°_c of C_6H_6, H_2 & C_6H_{14} are $-100, -50, -80$ kJ/mole Respectively

a) -300 kJ   b) -400 kJ

c) $+280$ kJ   d) NONE ✓

$$\Delta H^\circ_{rxn} = 1 \times (\Delta H^\circ_c)_{C_6H_6} + 3 \times (\Delta H^\circ_c)_{H_2} - 1 \times (\Delta H^\circ_c)_{C_6H_{14}}$$

$$= -100 - 150 + 80 = \underline{-170\,kJ}$$

Q46. Enthalpy of the reaction $CH_4 + O_2 \longrightarrow CH_3OH$ is negative. If enthalpy of combustion of CH_4 and CH_3OH are x and y respectively, then which relation is correct? [CBSE AIPMT 2001]

(a) $x > y$
(b) $x < y$
(c) $x = y$
(d) $x \geq y$

$CH_4 + O_2 \rightarrow CH_3OH$, $\Delta H = -ve$

$\Delta H^\circ_{rxn} = (\Delta H^\circ_c)_R - (\Delta H^\circ_c)_P$

$\Delta H^\circ_{rxn} = x - y$

$-ve$ $\quad y > x$

Q42. Heat of combustion H° for C(s), H_2(g) and CH_4(g) are –94, –68 and –213 kcal/mol. Then, ΔH° for

$C(s) + 2H_2(g) \rightarrow CH_4(g)$ is

[CBSE AIPMT 2002]

(a) –17 kcal/mol

(b) –111 kcal/mol

(c) –170 kcal/mol

(d) –85 kcal/mol

$$\Delta H^\circ_{Rxn} = (\Delta H^\circ_c)_R - (\Delta H^\circ_c)_P$$

$$1\times -94 + 2(-68) - (1\times -213)$$

$$-94 - 136 + 213$$

$$-230 + 213$$

$$= -17 \text{ kcal}$$

Q7. The heat of combustion of carbon to CO_2 is –393.5 kJ/mol. The heat released upon the formation of 35.2g of CO_2 from carbon and oxygen gas is [CBSE AIPMT 2015]

(a) –315 kJ
(b) +315 kJ
(c) –630 kJ
(d) –318 kJ

44g —— = −393.5 kJ

35.2g —— $-\frac{393.5}{44} \times 35.2$

= −314.8 kJ

Calorific value

measure efficiency of fuel

total amount of energy release in Combustion of 1 gram of Comp.

best fuel $\propto$ Calorific value

$$\text{Calorific value} = \frac{\Delta H_c^\circ \text{ of Comp.}}{\text{M.wt of Comp.}}$$

1 mole = ΔH_c°

M.wt gram = ΔH_c°

$1g = \frac{\Delta H_c^\circ}{\text{M.wt}}$

Q → Which is best fuel

a) CH_4 , $\Delta H_c^\circ = -160$ KJ/mole $-\frac{160}{16} = -10$ KJ/g

b) C_2H_6 $\Delta H_c^\circ = -200$ KJ/mole $= -\frac{200}{30} = -\frac{20}{3}$ KJ/g

c) both equal efficient

d) Can not say

Heat of Nuetralisation

$H^+ + OH^- \longrightarrow H_2O$, $\Delta H^0_N = -13.7$ Kcal

total amount of heat release (exo-) in nuetralisation of 1mole H^+ of Acid by 1mole OH^- of Base (1mole formatⁿ of $H_2O(l)$ by $H^+(aq)$ and $OH^-(aq)$.)

$H^+ + OH^- \longrightarrow H_2O$, $\Delta H^0_N = -13.7$ Kcal or -57.5 KJ

$HCl + NaOH \longrightarrow H_2O + NaCl$, $\Delta H^0_N = -13.7$ Kcal

$H^+ + Cl^- + Na^+ + OH^- \longrightarrow H-OH$

$HBr + KOH \longrightarrow KBr + H_2O, \quad \Delta H_N^\circ = -13.7\,KJ$

$H^+ + Br^- + K^+ + OH^- \longrightarrow H-OH + K^+ + Br^-$

Q → H.O.N. of 1 mole each acid H_2SO_4 & HCl by NaOH is $-x$ Kcal and $-y$ Kcal, select correct relation

a) $x > y$ ✓ b) $y > x$ c) $x = y$ d) NONE

$H_2SO_4 \rightarrow 2H^+ + SO_4^{-2}$ | $HCl \rightarrow H^+ + Cl^-$

$2H^+ + 2OH^- \rightarrow 2H_2O, \ -x\,KJ$ | $H^+ + OH^- \rightarrow H_2O, \ -y\,KJ$

$x = 2y \rightarrow x > y$

W.A. S.B

$CH_3COOH + NaOH \longrightarrow H_2O + CH_3COONa$

$\downarrow$ 5% $\downarrow$ 100%

$CH_3COO^- + H^+$ (5) $Na^+ + OH^-$ (100) $\longrightarrow H_2O$ (5), Energy release

Q → Select the nuetralisation rxn, in which max amount of Heat release

a) ✗ W.A $HCOOH + KOH \rightarrow HCOOK + H_2O$

b) ✓ S.A S.B $HCl + KOH \rightarrow H_2O + KCl$

c) ✗ W.B $HCl + NH_4OH \rightarrow NH_4Cl + H_2O$

Heat of Ionisation of weak Acid | weak Base

$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$, $\Delta H^\circ_N = -11.7$ Kcal

H.O.N + 13.7

$= -11.7 + 13.7$

$= 2$ Kcal

$\Delta H^\circ_N = -13.7$ Kcal

H.O.I. $= 13.7 - |H.O.N.|$ Kcal $= 57.5 - |H.O.N|_{KJ}$

↓

+ve (endo)

total amount of Heat requid (endo-) to ionisation of 1mole W.A or W.B.

Q → H.O.I. of CH_3COOH = $13.7 - 11.7 = 2$ Kcal/mole

Acidic strength

$HA \rightleftharpoons H^+ + A^- \rightarrow K_a$

W.A.

$K_a = \frac{[H^+][A^-]}{[HA]}$

Acidic strength $\propto [H^+]$

$K_a \propto [H^+]$

Acidic strength $\propto K_a$

Acidic strength $\propto$ |H.O.N.|

$\underline{CSD}$ → H.O.N. ⇒ $H^+ + OH^- \rightarrow H_2O$

→ S.A + S.B → H.O.N → fixed = −13.7 Kcal or −57.5 KJ per mole H^+/OH^-

→ Heat of formation of $H_2O(l)$ by $H^+(aq)$ & $OH^-(aq)$ = −13.7 Kcal or −57.5 KJ

→ W.A + S.B
→ S.A + W.B
→ W.A + W.B
} → H.O.N. < |13.7 Kcal or 57.5 KJ|

Reason = some amount heat used in ionisation of W.A / W.B.

H.O.I = 13.7 − |H.O.N.|$_{Kcal}$

H.O.I = 57.5 − |H.O.N.|$_{KJ}$

Acidic strength ∝ |H.O.N|

Q → Acid. H.O.N.

Acid	H.O.N.
HA	− 8.7 KCal
HB	− 10.4 KCal
HC	− 7.5 KCal

Acidic strength ∝ |H.O.N.|

HB > HA > HC

arrange Acidic strength

a) HA > HB > HC

b) HB < HA < HC

c) HC < HA < HBr ✓✓

d) NONE

Q → 1L, 2M HCl neutralise by required amount of NaOH.

(2 mole)

What amount of heat release in neutralisation

a) −13.7 Kcal

b) −10.5 Kcal

c) − 21.4 Kcal

d) NONE

$H^+ + OH^- \rightarrow H_2O \rightarrow \Delta H^\circ_N = -13.7$ Kcal

(H^+ → 2 mole)

2 mole = −13.7 × 2 = −27.4 Kcal

Mole = M × V(L)

MANTHAN NEET 2025

CHEMISTRY

thermodynamics

Lecture-12



Sarvesh Sir

Qsd-1

	Compound	ΔH_c°
(a)	CH_4	-250 KJ/mole $= -\frac{250}{16} = -15.6$
(b)	C_4H_{10}	-500 KJ/mole $= -\frac{500}{58} = -8.62$
(c)	C_2H_6	-400 KJ/mole $= -\frac{400}{30} = -13.33$

Efficiency of fuel

$\propto$ colarific value

which one is better fuel

~~(a)~~ a

(b) b

(c) c

(d) All equal better fuel

Qsd-2

Acid	H.O.N.
X	− 11.3 kcal
Y	− 9.7 Kcal
Z	− 13.7 Kcal

A.S $\propto$ |H.O.N.|

↳ Z > X > Y

Y → weakest

$\frac{?}{2}$

select the weakest Acid in given example

(a) X

(b) Y ✓

(c) Z

(d) All equal Acidic

Heat of Atomisation

Process ⇒ Natural form of element ⟶ Gaseous atom

total amount of heat required (endo-) in formation of 1 mole of gaseous atom by natural form of element (Most stable state)

Ex → $\frac{1}{2}H_2(g) \longrightarrow H(g)$, ΔH^0_A

$\frac{1}{2}I_2(s) \longrightarrow I(g)$, ΔH^0_A

$\frac{1}{2}Br_2(l) \longrightarrow Br(g)$, ΔH^0_A

$\frac{1}{2}Br_2(g) \longrightarrow Br(g)$, (X)

Q → $Cl_2(g) \longrightarrow 2Cl(g)$, $\Delta H = +420 KJ$

Calculate H.O.A.

a) +400 KJ

$H.O.A = +\frac{420}{2} = +210 KJ/mole$

b) +200 KJ

c) −200 KJ

✓d) NONE

13:3

CSD → Metal Ke Case ⇒ Metal → generally solid state me exist Krte hai

$$M(s) \longrightarrow M(g) \rightarrow \boxed{\Delta H^\circ_A = \Delta H^\circ_{sub}}$$

Except → $Ga(l)$, $Hg(l)$, $Cs(l)$

Q → $I_2(g) \longrightarrow 2I(g)$, $\Delta H = +500\,KJ$

$I_2(s) \longrightarrow 2I(g)$, $\Delta H = +600\,KJ$ ✓

Calculate value of H.O.A.

a) +250KJ

b) +300KJ ✓✓

c) +1000KJ

d) +1200KJ

Bond enthalpy or Bond dissociation energy

Process ⇒ Gaseouses Molecules ⟶ Gaseouses atom

total amount of energy required (endo-) to break 1 mole of Covalent bond

Ex → $H_2(g) \longrightarrow 2H(g)$, ΔH^0_b

H–H

Ex → $I_2(g) \longrightarrow 2I(g)$, ΔH^0_b

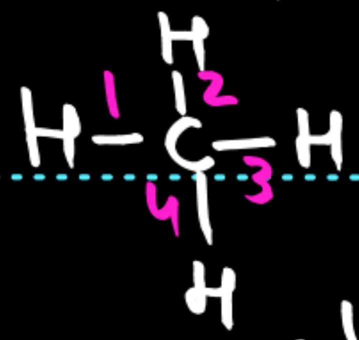
(I–I)

Ex → $H_2O(g) \longrightarrow 2H(g) + O(g)$, $\Delta H^\circ = +400\,KJ$

$H \overset{}{\underset{1}{-}} O \underset{2}{-} H$

Bond enthalpy of H–O $= +\frac{400}{2} = +200\,KJ/mole$

Ex → $CH_4(g) \longrightarrow C(g) + 4H(g)$, $\Delta H = +1000\,KJ$



Bond enthalpy of C–H =

$= 4$ C–H bond $= +\frac{1000}{4} = +250\,KJ/mole$

Q → H.O.A and Bond enthalpy of I_2 is $+x$ KJ and $+y$ KJ respectively select correct relation

a) $x = y$

~~b)~~ $x > y$

c) $x < y$

d) NONE

$\frac{1}{2} I_2(s) \longrightarrow I(g), \Delta H^\circ_A$

$I_2(g) \longrightarrow 2I(g), \Delta H^\circ_b$

CSD ⇒ Heat of reaction in term of Bond enthalpy

$$\Delta H^{\circ}_{rxn} = (\Delta H^{\circ}_{b})_{Reactant} - (\Delta H^{\circ}_{b})_{product}$$

Q20. For the following bond energies:

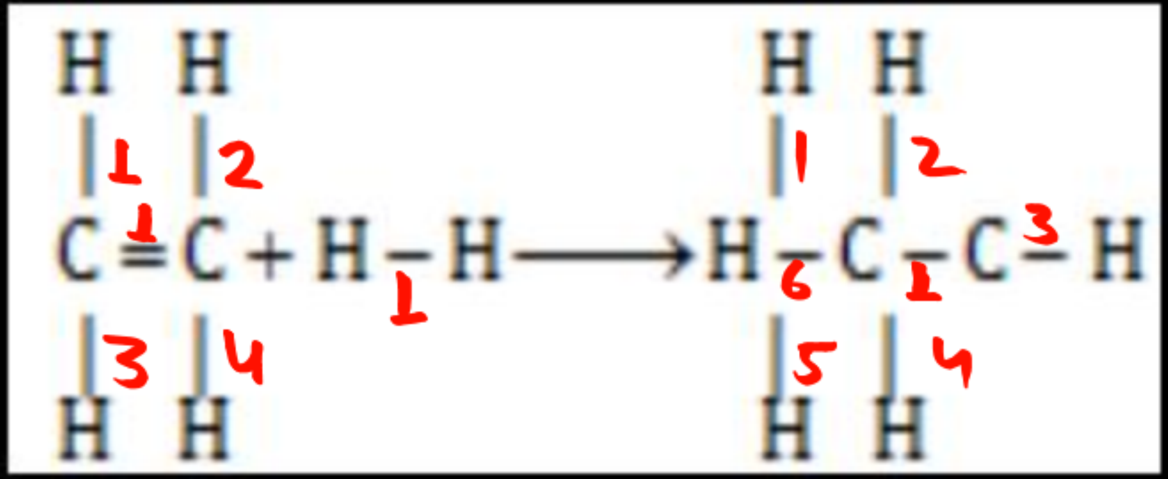
H – H bond energy : 431.37 kJ mol^{-1}

C = C bond energy : 606.10 kJ mol^{-1}

C – C bond energy : 336.49 kJ mol^{-1}

C – H bond energy : 410.50 kJ mol^{-1}

Enthalpy for the reaction,



Will be:

[CBSE AIPMT 2009]

(a) 1523.6 kJ mol^{-1}

(b) –243.6 kJ mol^{-1}

(c) –120.0 kJ mol^{-1}

(d) 553.0 kJ mol^{-1}

$\Delta H^\circ_{rxn} = (\Delta H^\circ_b)_R - (\Delta H^\circ_b)_P$

$= [(4 \times 410.5) + 1 \times 606.10 + 1 \times 431.37] - [6 \times 410.5 + 1 \times 336.46]$

$= -120.02$ kJ

Q36. If the bond energies of H – H, Br – Br and H – Br are 433, 192 and 364 kJ mol^{-1} respectively, then $\otimes H^\circ$ for the reaction $H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$ is **[CBSE AIPMT 2004]**

(a) –261 kJ

(b) +103 kJ

(c) +261kJ

(d) –103 kJ

H–H

Br–Br

H–Br

$$\Delta H^\circ_{rxn} = (\Delta H^\circ_b)_R - (\Delta H^\circ_b)_P$$

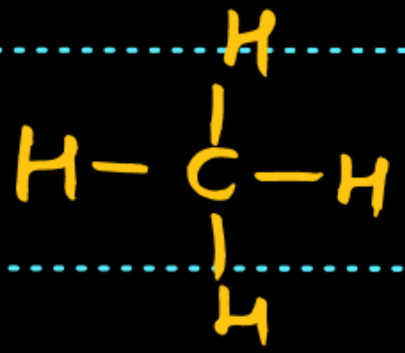
$$= (1\times 433 + 1\times 192) - 2\times 364$$

$$= 625 - 728$$

$$= -103 \text{ kJ}$$

Q → total amount of heat release in given rxn for 4gram of CH_4 is + 150KJ

10 Rs →



$$CH_4(g) \longrightarrow C(g) + 4H(g)$$

Calculate bond diss. Energy of C–H bond = 1mole C–H = ?

a) +150KJ

b) +600KJ

c) $+\frac{150}{4}$KJ

d) NONE

$$4g\ CH_4 = \frac{4}{16} = \frac{1}{4}\text{ mole } CH_4 = \frac{1}{4} \times 4 \text{ mole C–H bond}$$

$$= 1\text{mole C–H bond}$$

Hess's law

→ Enthalpy = state $funct^n$

→ Enthalpy depend upon only initial and final state

$$C(s) + O_2(g) \xrightarrow{\Delta H_1} CO_2(g)$$

initial ... final

$$C(s) \xrightarrow{\frac{1}{2}O_2} CO(g) \quad \Delta H_2$$

(initial)

$$CO(g) \xrightarrow{\frac{1}{2}O_2} CO_2(g) \quad \Delta H_3$$

(final)

$$\Delta H_1 = \Delta H_2 + \Delta H_3$$

Phase trasition

Vapourization liquid → vapour (g)

total amount of energy required (endo) in vapourizahon of 1mole liquid into its vapour → $\Delta H^0_{vap} = +ve$

Enthalpy of Fusion liquid → Solid → $\Delta H^0_{fus} = -ve$

total amount of energy release (exo) in freezing of 1mole liquid into solids

Enthalpy of melting solid → liquid, $\Delta H^\circ_{melting} = +ve$

total amount of heat required (endo) in conversion of 1 mole solid into its liquid

$$|\Delta H^\circ_{fus}| = \Delta H^\circ_{melting}$$

Enthalpy of Sublimation Solid ⟶ vapour (gas) → ΔH°_{sub}

total amount of heat required (endo) in conversion of 1 mole solid into its vapour

$$\text{Solid} \xrightarrow{|\Delta H^\circ_{fus}|} \text{liquid} \xrightarrow{\Delta H^\circ_{vap}} \text{vapour}$$

$$\Delta H^\circ_{sub} = |\Delta H^\circ_{fus}| + \Delta H^\circ_{vap}$$

Heat of Hydration, Heat of dilution & Heat of solution

H·O·S = ΔH°_{soln}

H·O·H: $CuSO_4 + 5H_2O \longrightarrow CuSO_4 \cdot 5H_2O$

H·O·D: $CuSO_4 \cdot 5H_2O \longrightarrow CuSO_4 \cdot 15H_2O$

$$CuSO_4 + 5H_2O \longrightarrow CuSO_4 \cdot 5H_2O \longrightarrow CuSO_4 \cdot 15H_2O \longrightarrow CuSO_4 \cdot xH_2O$$

($CuSO_4 \cdot xH_2O$: Saturated state)

Hydration = fixed No. of H_2O Add

dilution = fixed No. < dilution < Saturated state

Solution = Saturated state (max. H_2O Add)

Q.

The heat of solution of anhydrous CuSO4 is – 15.9 kcal and that of CuSO4.5H2O is -2.8 kcal. Calculate the heat of hydration of CuSO4

$$CuSO_4 \longrightarrow CuSO_4 \cdot max\ H_2O \rightarrow -15.9\ Kcal$$

$$CuSO_4 \cdot 5H_2O \longrightarrow CuSO_4 \cdot max\ H_2O \rightarrow -2.8\ Kcal$$

$$15.9 = \Delta H^0_H + 2.8$$

$$\Delta H^0_H = -13.1$$

$$CuSO_4 + 5H_2O \longrightarrow CuSO_4 \cdot 5H_2O \rightarrow \Delta H^0_H = ?$$

$$CuSO_4 \longrightarrow CuSO_4 \cdot 5H_2O \longrightarrow CuSO_4 \cdot Max\ H_2O$$

$CuSO_4 \cdot 5H_2O \to CuSO_4 \cdot Max\ H_2O$: -2.8 Kcal

$CuSO_4 \to CuSO_4 \cdot Max\ H_2O$: -15.9 Kcal

$$15.9 - 2.8 = -13.1$$

Q → $FeSO_4$ (s) → H·O·S = −20 Kcal

$FeSO_4 \cdot 7H_2O$ → H·O·S = −8 Kcal

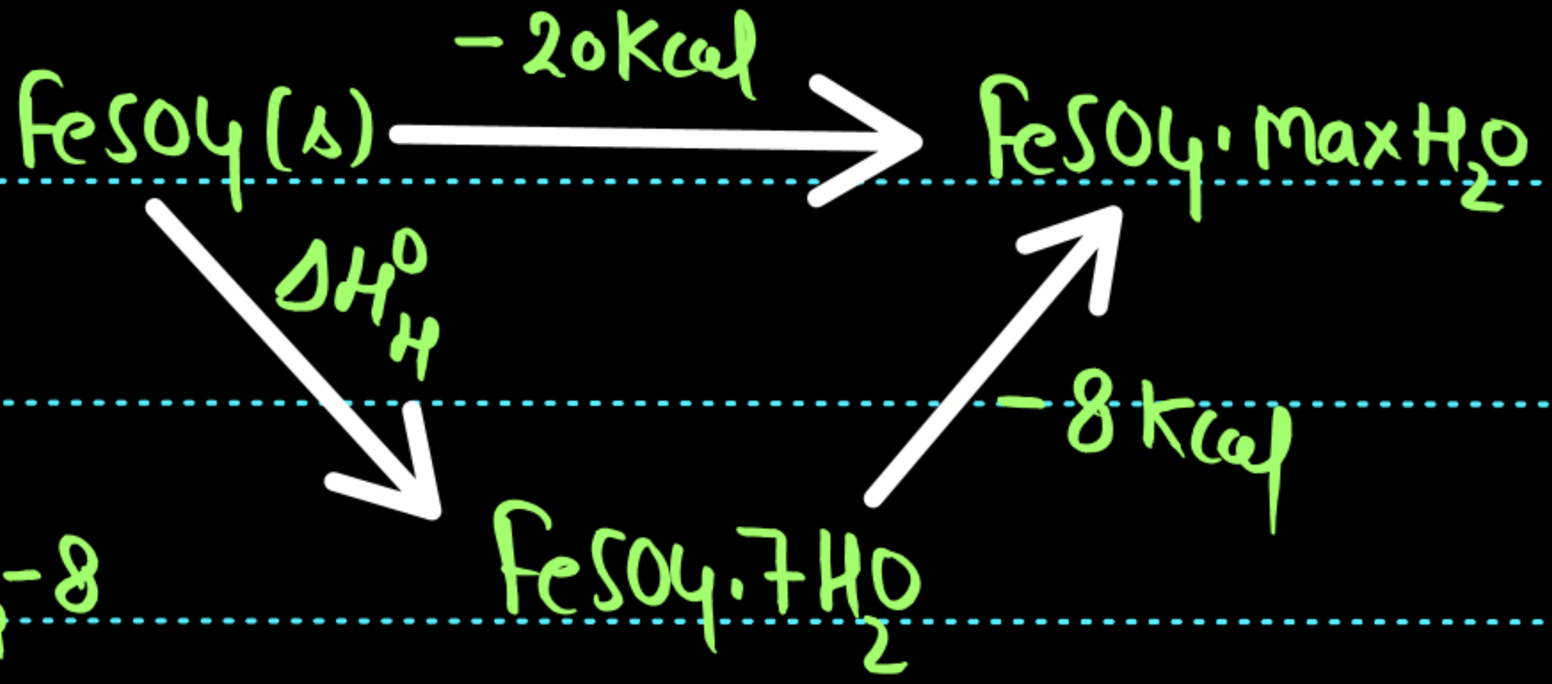
$FeSO_4 + 7H_2O \longrightarrow FeSO_4 \cdot 7H_2O$, $\Delta H^o_H = ?$

a) −12 Kcal

b) +12 Kcal

c) +28 Kcal

d) −28 Kcal



$-20 = \Delta H^o_H - 8$

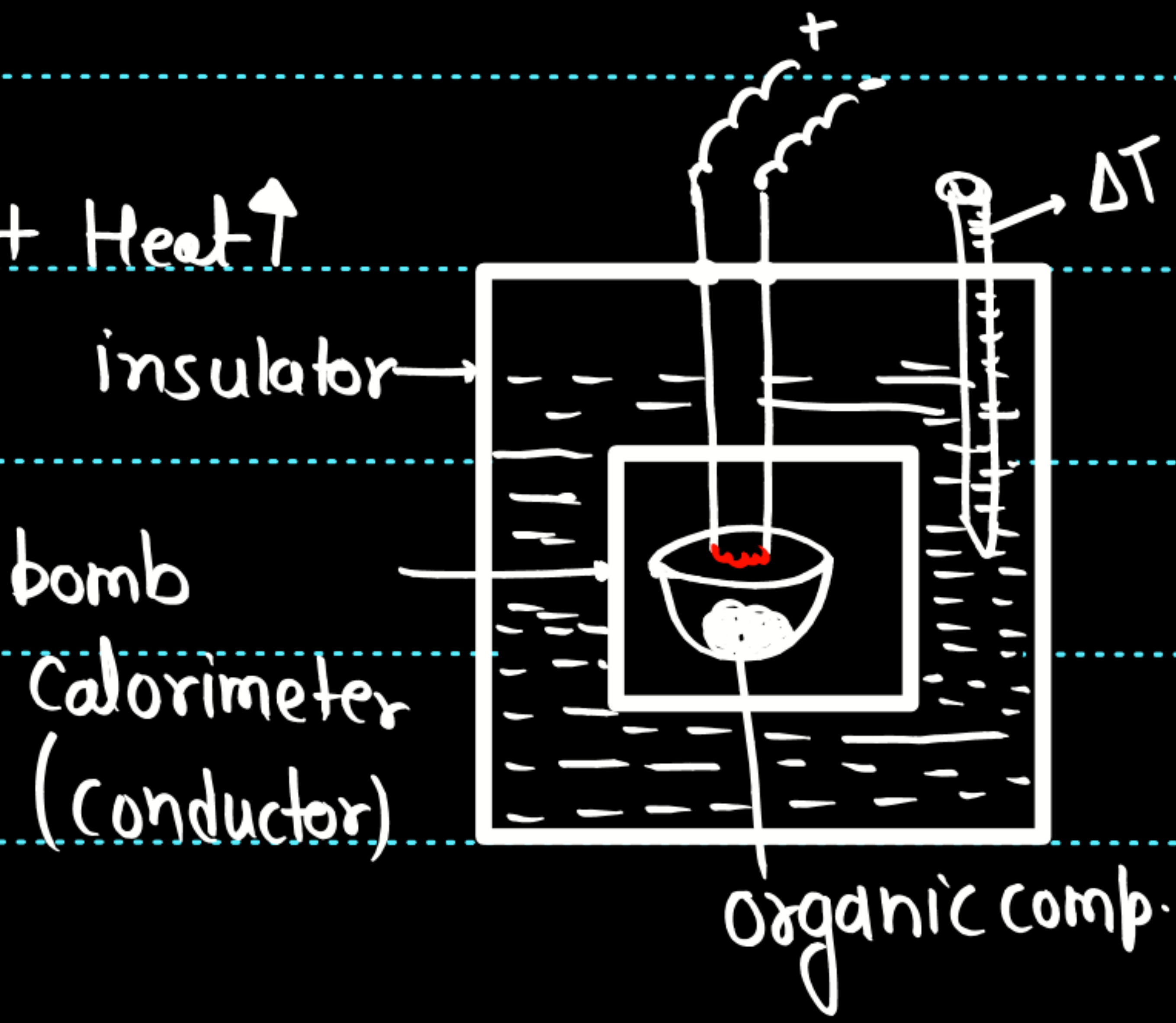
$\Delta H^o_H = -12$ Kcal

Bomb Calorimeter

It is a device, which is measure heat of Combustion of compound at Constant volume

$$\text{Hydrocarbon} + O_2 \rightarrow \underset{(g)}{CO_2} + H_2O(l) + \text{Heat}\uparrow$$

$$q_v = dU$$



$$dU = q_v = \frac{\text{Heat capacity of Calorimeter} \times \Delta T \times \text{M.wt of Comp.}}{\text{Mass of Compound}}$$

$$q_p = dH = dU + \Delta n_g RT$$

For the complete combustion of ethanol,

$$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l),$$ $\rightarrow \Delta n_g = 2-3 = -1$ $\quad \Delta U = q_v$

the amount of heat produced as measured in bomb calorimeter, is 1364.47 kJ mol^{-1} at 25°C. Assuming ideality the enthalpy of combustion, $\Delta_c H$, for the reaction will be (R = 8.314 J K^{-1} mol^{-1})

[redacted]

(A) –1366.95 kJ mol^{-1} (B) –1361.95 kJ mol^{-1}

(C) –1460.50 kJ mol^{-1} (D) –1350.50 kJ mol^{-1}

$$\Delta H = \Delta U + \Delta n_g RT = -1364.47\,kJ + (-1) \times 8.314 \times 10^{-3}\,kJ \times 298$$
$$= -1364.4 - 2.477$$
$$= -1366.94\,kJ$$

Q21. Bond dissociation enthalpy of H_2, Cl_2 and HCl are 434, 242 and 431 kJ mol^{-1} respectively. Enthalpy of formation of HCl is [CBSE AIPMT 2008]

(a) 93 kJ mol^{-1}
(b) –245 kJ mol^{-1}
(c) –93 kJ mol^{-1}
(d) 245 kJ mol^{-1}

Given:

(i) $C(\text{graphite}) + O_2(g) \rightarrow CO_2(g); \Delta_r H^\ominus = x \text{ kJ mol}^{-1}$

(ii) $C(\text{graphite}) + \frac{1}{2} O_2(g) \rightarrow CO_2(g); \Delta_r H^\ominus = y \text{ kJ mol}^{-1}$

(iii) $CO(g) + \frac{1}{2} O_2(g) \rightarrow CO_2(g); \Delta_r H^\ominus = z \text{ kJ mol}^{-1}$

(A) $y = 2z - x$

(B) $x = y - z$

(C) $z = x + y$

(D) $x = y + z$

Q48. Change in enthalpy for reaction $2H_2O_2(l) \longrightarrow 2H_2O(l) + O_2(g)$ if heat of formation of $H_2O_2(l)$ and $H_2O(l)$ are –188 and –286 kJ /mol respectively is

[CBSE AIPMT 2001]

(a) –196 kJ/mol
(b) +196 kJ/mol
(c) +948 kJ/mol
(d) –948 kJ/mol


Manthan-NEET-2025 Batch
CHEMICAL
EQUILIBRIUM
LECTURE - 1
CLASS 11
SANKALP NEET
VEDANTU
Vedantu
MASTER TEACHER

Today's Goal -

Equilibrium constant

Equilibrium state

a) Close Container

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

initial state $N_2 + 3H_2 \longrightarrow 2NH_3(g)$

After some time $2NH_3 \longrightarrow N_2 + 3H_2$

$N_2 + 3H_2 \longrightarrow 2NH_3$

$2NH_3 \longrightarrow N_2 + 3H_2$

$\rightarrow 2N_2 + 3H_2 \rightleftharpoons 2NH_3$

forward direction

Equilibrium sign

backward

CSP

* at Equilibrium

→ $\Delta G = 0$

→ Rate of forward Reaction = Rate of backward Reaction ($R_f = R_b$)

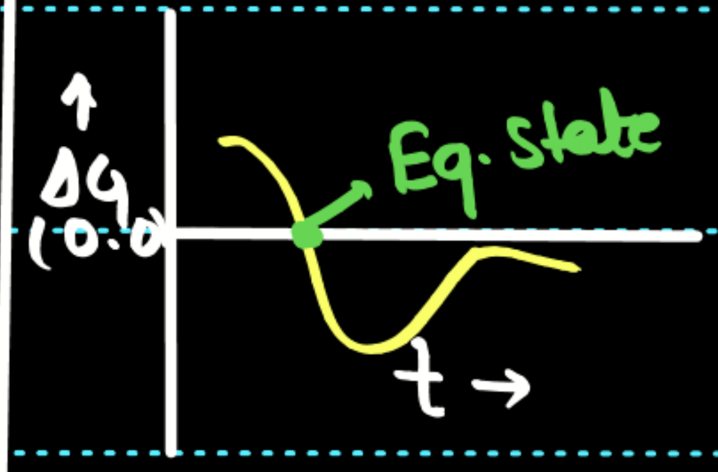
→ Concentration of Reactant and product are constant

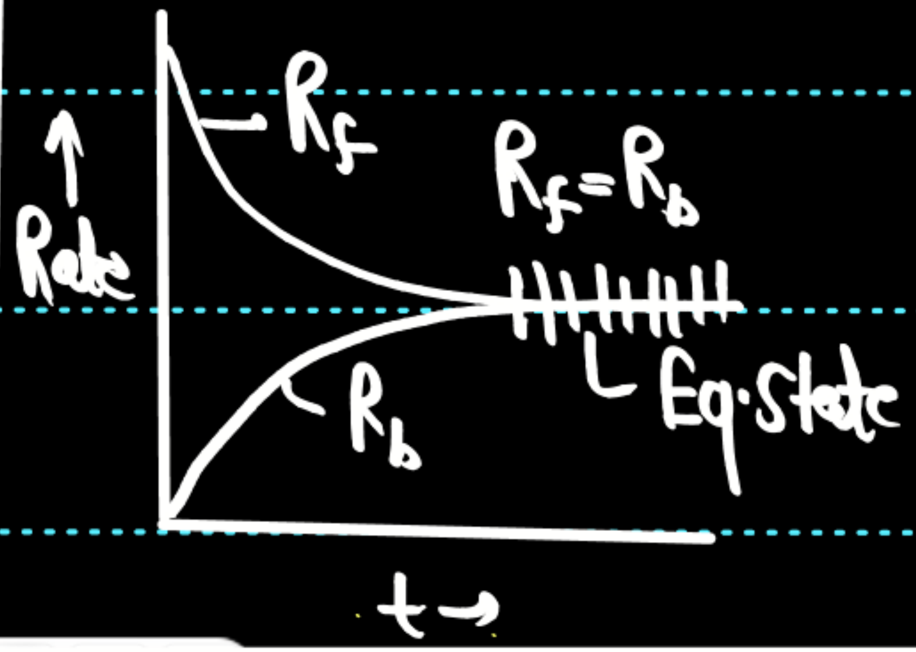
a) [Reactant] > [Product]

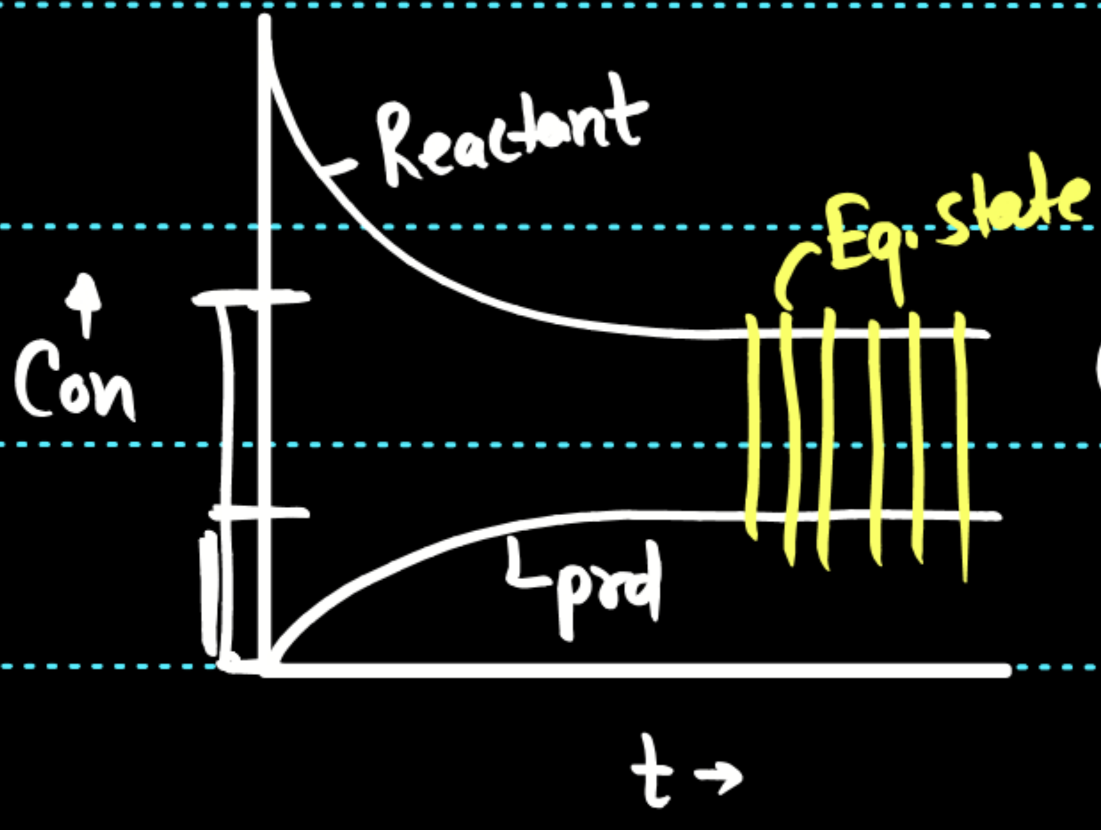
b) [Reactant] < [product]

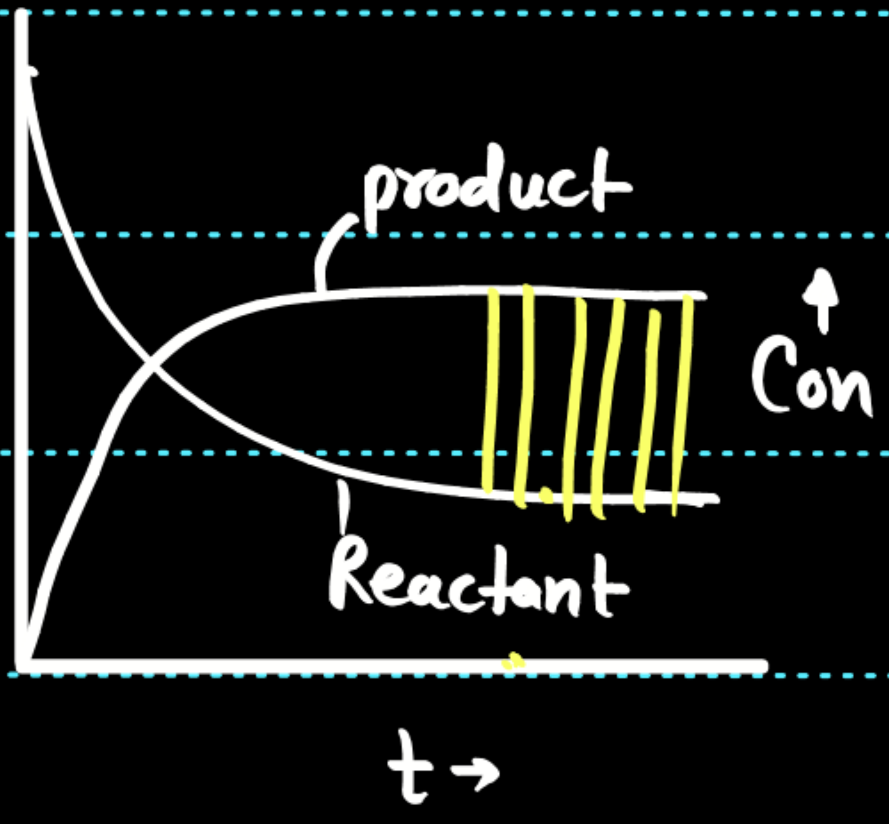
c) [Reactant] = [product]

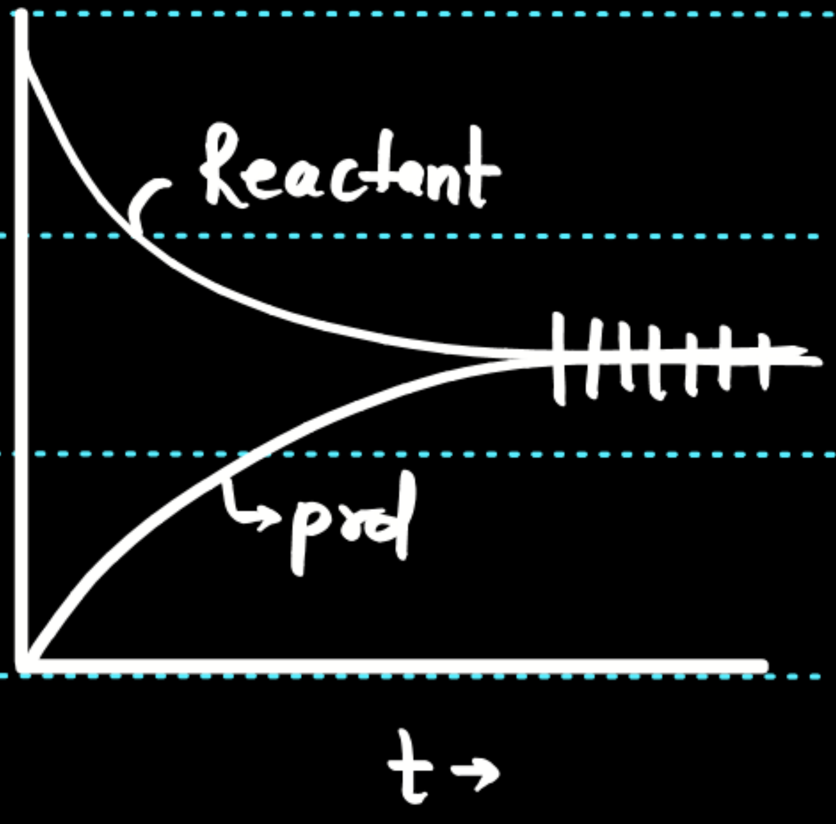
→ Equilibrium = dynamic state









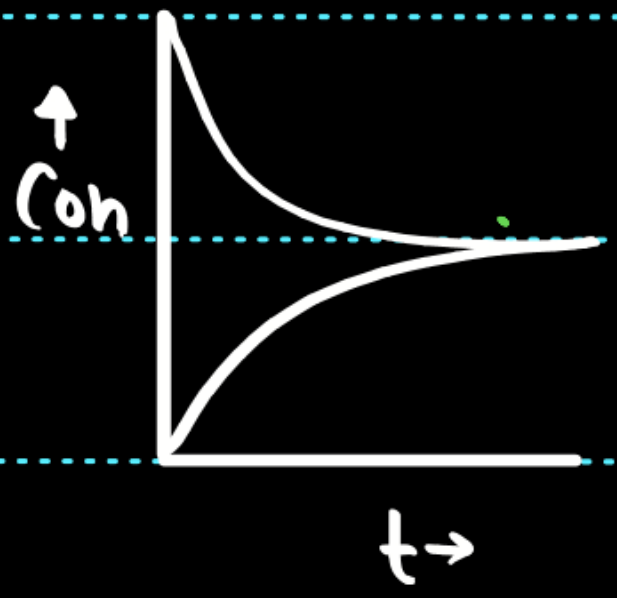


[React^n] > [prd] [React^n] < [Prd] [Reactant] = [prd]

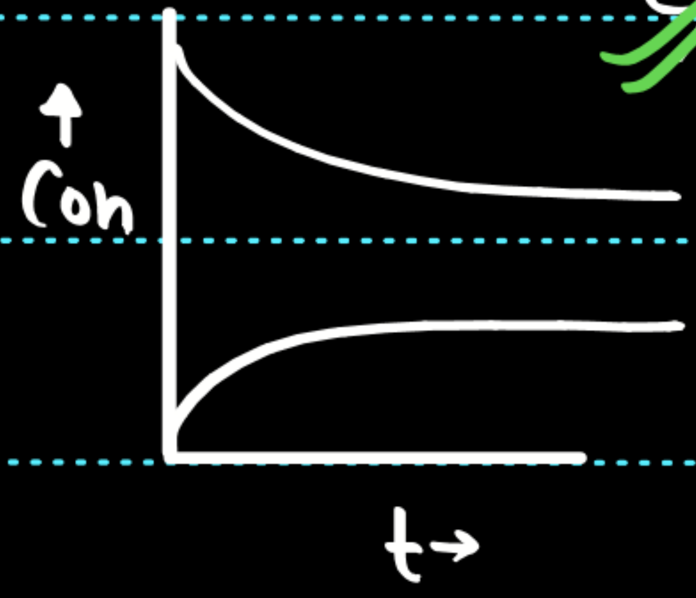
Q→ $A \rightleftharpoons B$, at Equilb^m 2 mole A and 3 mole B present in close container, select Correct graphical Representation

(React^n under "2 mole A"; prd under "3 mole B")

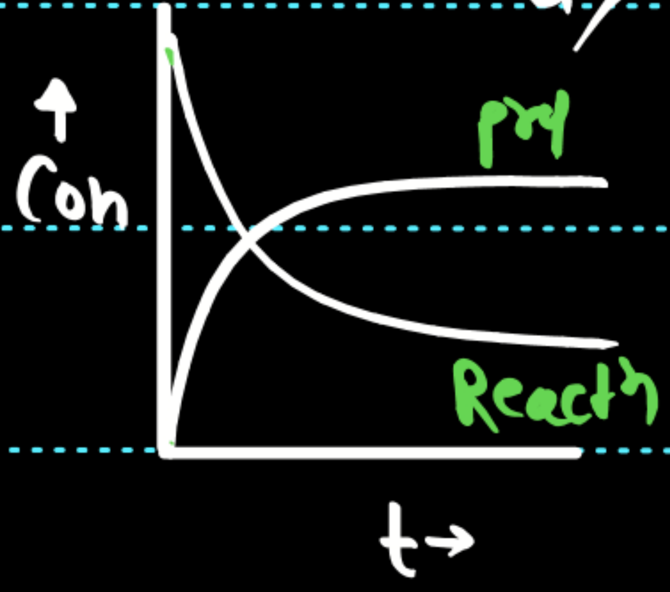
a) X



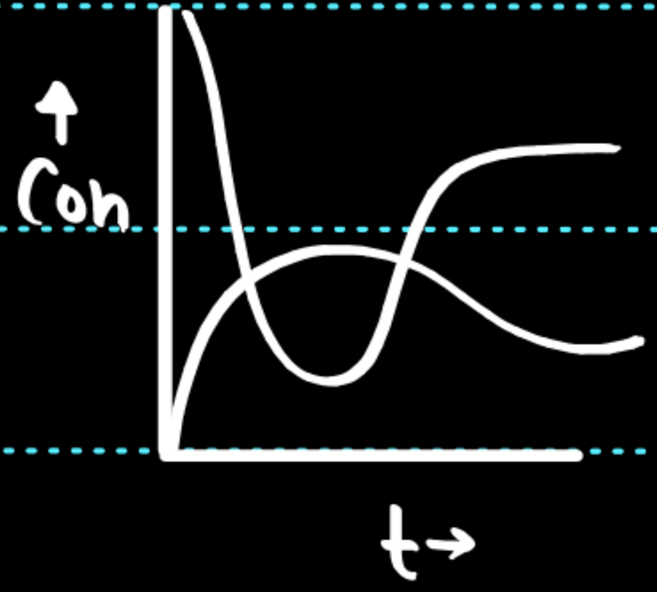
b) X



c)

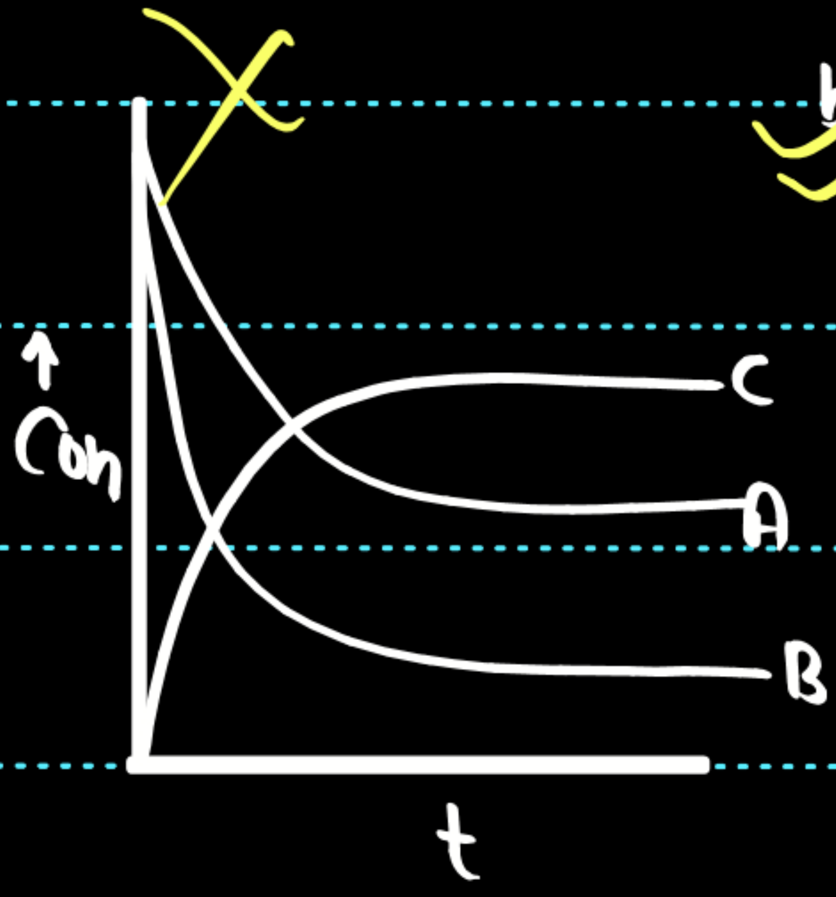


d) X

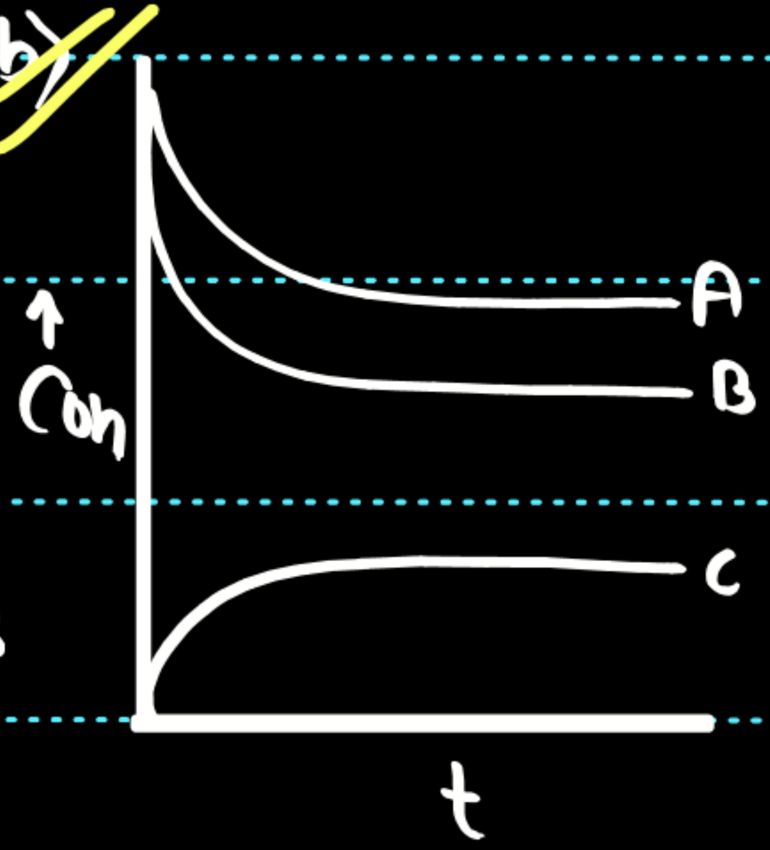


Q→ $A + B \rightleftharpoons C$, initially 10 mole A and 8 mole B taken in a close container, at Equilibrium 3 mole of C is form, select Correct graphical Representation of given Rxn.

a)



b)



c) NONE

A +	B ⇌	C	
10	8	0	t=0
10−x	8−x	x	at Eq.
10−3	8−3	3	"
7	5	3	"

Equilibrium Constant

$$A \rightleftharpoons B$$

Rate of forward reaction ($A \rightarrow B$)

$$R_f = K_f [A_t]^1 \quad \text{— (1)}$$

└ Rate Const. of forward rxn

Rate of backward rxn ($B \rightarrow A$)

$$R_b = K_b [B_t]^1 \quad \text{— (2)}$$

at Equilibrium

$$R_f = R_b$$

$$K_f [A_t]^1 = K_b [B_t]^1$$

$$\frac{K_f}{K_b} = \frac{[B_t]}{[A_t]}$$

$$K_{eq} = \frac{K_f}{K_b} = \frac{[B_t]}{[A_t]}$$

Eq. Const is equal to ratio of Rate Const. of forward rxn and Rate Const of backward rxn

OR

Eq. Const is equal to ratio of Concentration of product and Concentration of Reactant at Equilibrium state

CSD

→ intensive properties

→ Equilibrium const. only depend upon temperature and Stoichiometric Coefficient of Reactant & product

→ Pressure → change → ✗

→ volume - change → ✗

→ Shape, size of container → ✗

Rule = 1 $A \rightleftharpoons B \rightarrow K$

$nA \rightleftharpoons nB \rightarrow K_{New} = K^n$

Rule = 2 $\frac{1}{n}A \rightleftharpoons \frac{1}{n}B \rightarrow K_N = (K)^{\frac{1}{n}}$

Rule = 3 $B \rightleftharpoons A \rightarrow K_N = \frac{1}{K}$

Rule = 4 $A \rightleftharpoons B \rightarrow K_1$

$C \rightleftharpoons D \rightarrow K_2$

$A + C \rightleftharpoons B + D \rightarrow K_N = K_1 \times K_2$

Q → $2NO_2 + \frac{1}{2}O_2 \rightleftharpoons N_2O_5$ → $K = 10^4$

Calculate Keq

Q-1 $4NO_2 + O_2 \rightleftharpoons 2N_2O_5$, $K = ?$

a) 10^4 b) 10^2 ✓ c) 10^8 d) 10^{-8} → $K_N = (10^4)^2 = 10^8$

Q-2 $NO_2 + \frac{1}{4}O_2 \rightleftharpoons \frac{1}{2}N_2O_5$ → $K = ?$

a) 10^4 ✓ b) 10^2 c) 10^8 d) 10^{-8} → $K_N = (10^4)^{\frac{1}{2}} = (10)^{4 \times \frac{1}{2}} = 10^2$

Q-3 - $N_2O_5 \rightleftharpoons 2NO_2 + \frac{1}{2}O_2$ → $K = ?$ $K_N = \frac{1}{10^4} = 10^{-4}$

✓ a) 10^{-4} b) 10^{-2} c) 10^8 d) 10^{-8}

Q $H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$, $K_1 = 10^7$ — ①

$HCO_3^- \rightleftharpoons H^+ + CO_3^{-2}$, $K_2 = 10^{-2}$ — ②

Calculate Keq. of $H_2CO_3 \rightleftharpoons 2H^+ + CO_3^{-2}$ → $K_N = K_1 \times K_2 = 10^7 \times 10^{-2}$

$= 10^5$

a) 10^5 ① + ②

b) 10^9 $H_2CO_3 + HCO_3^- \rightleftharpoons 2H^+ + HCO_3^- + CO_3^{-2}$

c) 10^{-9} $H_2CO_3 \rightleftharpoons 2H^+ + CO_3^{-2}$ b) $2H^+ + CO_3^{-2} \rightleftharpoons H_2CO_3 \rightarrow Keq$

d) 10^{-5}

$K_e = 10^5 \rightarrow K_N = \frac{1}{10^5} = 10^{-5}$

Q → $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

1 mole PCl_5 initially taken in rxn, and Eq. Const of Rxn is 1.5×10^3, If amount of PCl_5 taken double than new Eq. Const value is become ______

a) double

b) half

c) same

d) 4 times

Q → $N_2 + 3H_2 \rightleftharpoons 2NH_3 \Rightarrow K_{eq} = 10^6$

$NH_3 \rightleftharpoons \frac{1}{2}N_2 + \frac{3}{2}H_2 = K = ?$

a) 10^{-6} ~~b)~~ 10^{-3} c) 10^{-12} d) 10^{3}

Solⁿ = $\left(\frac{1}{10^6}\right)^{\frac{1}{2}}$ $\left(\frac{1}{10^6}\right)^{\frac{1}{2}}$

$= (10^{-6})^{\frac{1}{2}} = 10^{-6\times\frac{1}{2}} = 10^{-3}$

13:3

Q1. The equilibrium constants of the following are

[NEET 2017, CBSE AIPMT 2007]

$N_2 + 3H_2 \rightleftharpoons 2NH_3\ ;\ K_1$ → $2NH_3 \rightarrow N_2 + 3H_2 \rightarrow \frac{1}{K_1}$ — (I)

$N_2 + O_2 \rightleftharpoons 2NO\ ;\ K_2$ — (II)

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O\ ;\ K_3$ → $3H_2 + \frac{3}{2}O_2 \rightarrow 3H_2O \rightarrow K_3^3$ — (III)

The equilibrium constant (K) of the reaction

$2NH_3 + \frac{5}{2}O_2 \overset{k}{\rightleftharpoons} 2NO + 3\ H_2O$ will be

(a) $\frac{K_1 K_3^3}{K_2}$

(b) $\frac{K_2 K_3^3}{K_1}$

(c) $\frac{K_2 K_3}{K_1}$

(d) $\frac{K_2^3 K_3}{K_1}$

(1) + (2) + (3)

$\frac{1}{K_1} \times K_2 \times K_3^3$

$2NH_3 + \frac{5}{2}O_2 \rightarrow 2NO + 3H_2O$

Q3. If the equilibrium constant for is $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ K, the equilibrium constant for $\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO(g)$ will be

[CBSE AIPMT 2015]

$(K)^{\frac{1}{2}}$

(a) $K^{1/2}$

(b) $\frac{1}{2}K$

(c) K

(d) K^2

Q14. In the two gaseous reactions (i) and (ii) at 250ºC

[CBSE AIPMT 2005, 1994]

I. $NO(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO_2(g), K_1$

II. $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g), K_2$

The equilibrium constant K_1 and K_2 are related as

(a) $K_2 = \frac{1}{K_1}$

(b) $K_2 = K_1^{1/2}$

(c) $K_2 = \frac{1}{K_1^2}$

(d) $K_2 = K_1^2$

$NO_2 \rightarrow NO + \frac{1}{2}O_2 \rightarrow \frac{1}{K_1}$

$2NO_2 \rightarrow 2NO + O_2 \rightarrow \left(\frac{1}{K_1}\right)^2 = \frac{1}{K_1^2} = K_1^{-2}$

$K_2 = K_1^{-2} = \frac{1}{K_1^2}$

Q19. If K_1 and K_2 are the respective equilibrium constant for the two reactions,

$XeF_6(g) + H_2O(g) \rightleftharpoons XeOF_4(g) + 2HF(g)$, $XeO_4(g) + XeF_6(g) \rightleftharpoons XeOF_4(g) + XeO_3F_2(g)$. — ②

The equilibrium constant of the reaction $XeO_4(g) + 2HF(g) \rightleftharpoons XeO_3F_2(g) + H_2O(g)$ will be

$XeOF_4 + 2HF \rightarrow XeF_6 + H_2O \rightarrow \frac{1}{K_1}$ — ①

[CBSE AIPMTA 1998]

(a) $\frac{K_1}{(K_2)^2}$

(b) $K_1 . K_2$

(c) $\frac{K_1}{K_2}$

(d) $\frac{K_2}{K_1}$

① + ② $XeO_4 + 2HF \rightarrow XeO_3F_2 + H_2O \rightarrow K = \frac{1}{K_1} \times K_2 = \frac{K_2}{K_1}$

Q25. K_1 and K_2 are equilibrium constant for reactions (i) and (ii)

i. $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

ii. $NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$

(a) $K_1 = \left[\frac{1}{K_2}\right]^2$

(b) $K_1 = K_2^2$

(c) $K_1 = \frac{1}{K_2}$

H.W.

(d) $K_1 = (K_2)^0$

For the following reactions, equilibrium constants are given:

$$S(s) + O_2(g) \rightleftharpoons SO_2(g); \; K_1 = 10^{52}$$

$$2S(s) + 3O_2(g) \rightleftharpoons 2SO_3(g); \; K_2 = 10^{129}$$

The equilibrium constant for the reaction: $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ is:

[2019 Main, 8 April II]

(a) 10^{25}

(b) 10^{77}

(c) 10^{154}

(d) 10^{181}

NEET- F.Y.Q

$2SO_2 \rightarrow 2S(s) + 2O_2 \rightarrow \left(\frac{1}{10^{52}}\right)^2$ — ①

— ②

① + ②

$$2SO_2 + O_2 \rightarrow 2SO_3 \rightarrow K = 10^{129} \times \frac{1}{10^{104}}$$

$$= 10^{129-104}$$

$$= 10^{25}$$

Consider the following reversible chemical reaction, **[2019 Main, 9 Jan II]**

NEET-PYQ = 2025

$$A_2(g) + B_2(g) \underset{}{\overset{K_1}{\rightleftharpoons}} 2AB(g) \quad .....(i)$$

$$6AB(g) \underset{}{\overset{K_2}{\rightleftharpoons}} 3A_2(g) + 3B_2(g) \quad ....(ii)$$

The relation between K_1 and K_2 is:

(a) $K_2 = K_1^{3}$ $\left(\frac{1}{K_1}\right)^3$

(b) $K_1K_2 = 3$

(c) $K_2 = K_1^{-3}$ ✓

(d) $K_1K_2 = \frac{1}{3}$

$K_2 = \left(\frac{1}{K_1}\right)^3$

$= K_2 = \frac{1}{K_1^3} = K_1^{-3}$

MANTHAN NEET 2025

SANKALP NEET VEDANTU

CHEMISTRY

chemical equilibrium

Lecture-02

Atomic structure
22→28%
Qsd
7pm → live
SMART Series
→ Tuesday →



Sarvesh Sir

Qsd-1 $N_2 + 3H_2 \rightleftharpoons 2NH_3$, $K_{eq} = 1.5 \times 10^3$

If the amount of N_2 & H_2 is double than value of K_{eq} is

a) double ✗

b) $K_{eq} > 1.5 \times 10^3$ ✗

c) $K_{eq} < 1.5 \times 10^3$ ✗

d) NONE

K_{eq} → only depend upon temp.

$K_{eq} = 1.5 \times 10^3$

Qsd-3

$H_2S \rightleftharpoons H^+ + HS^- \rightarrow K_1 = 10^{-4}$

$HS^- \rightleftharpoons H^+ + S^{-2} \rightarrow K_1 = 10^{-9}$

Calculate Keq of given rxn

$2H^+ + S^{-2} \rightleftharpoons H_2S$

a) 10^{-13}

b) 10^{13}

c) 10^{-5}

d) 10^{5}

$\frac{?}{2}$

$H_2S \rightleftharpoons 2H^+ + S^{-2} \rightarrow K = 10^{-9} \times 10^{-4}$

$= 10^{-13}$

$2H^+ + S^{-2} \rightleftharpoons H_2S \rightarrow K = \frac{1}{10^{-13}} = 10^{13}$

Type of Equilibrium Rxn in basis of physical state

1) **Homogeneous Eq. Rxn** Reactant & product = phase (physical state) ⇒ same

2) **Heterogeneous Eq. Rxn** Reactant & product = phase (physical state) = different

$$\underset{(s)}{CaCO_3} \rightleftharpoons \underset{(s)}{CaO} + \underset{(g)}{CO_2}$$

Q → $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

Q → $CH_3COOH(l) + C_2H_5OH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$

Q → Select Heterogeneous Equilibrium Reaction

↗ different phase

a) $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ ✗

b) $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$ ✓✓

c) $2NO(g) \rightleftharpoons N_2O_2(g)$ ✗ D) NONE ✗

Equilibrium Const in term of Molar Concentration (Active Mass)

Active Mass Con. of Reactant & product which is change (Active participate) in Chemical Equilibrium Reaction

→ Represent → [ ] → square bracket

→ formula → $[A] \propto$ molarity

$[A] = KM$

$K = 1$ for aq. solⁿ and gas

$[A] = M$

→ Keq in term of Active Mass is known as Kc (Eq. Const in term of Active Mass)

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$$K_{eq} = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

↓

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

Active mass or molarity term me liye hai

Q → Equilibrium Con. of HCl, H_2 & Cl_2 is 2.0, 2.0 and 6.0 $\frac{\text{mole}}{\text{litre}}$ respectivly

Calculate Eq Constant

$2HCl \rightleftharpoons H_2 + Cl_2$

$$K_c = \frac{[H_2][Cl_2]}{[HCl]^2} = \frac{2 \times 6}{2 \times 2} = 3$$

$K_c = 3$

Equilibrium Const in term of partial pressure

→ Equilibrium Rxn → minimum ek gas (reactant & product)

→ partial pressure = Mole fraction × total pressure of close Container

→ $\underset{(g)}{PCl_5} \rightleftharpoons \underset{(g)}{PCl_3} + \underset{(g)}{Cl_2}$

$P_{PCl_3} = X_{PCl_3} \times P_T$

$P_{Cl_2} = X_{Cl_2} \times P_T$

$P_{PCl_5} = X_{PCl_5} \times P_T$

$$K_{eq} = \frac{(P_{PCl_3})^1 \times (P_{Cl_2})^1}{(P_{PCl_5})^1}$$

↓

K_p → Eq. Constant in term of partial pressure

Q → $N_2 + 3H_2 \rightleftharpoons 2NH_3$ $1+2+3 = 6$ mole

at Equilibrium mole of N_2, H_2 & NH_3 in Equilibrium gaseous mixture is (1), (2), (3) respectively and total pressure of container is 6 atm, Calculate Eq. Const. of rxn.

a) 5

b) 7.5

c) 2.5

~~d) NONE~~

$$K_p = \frac{(P_{NH_3})^2}{(P_{N_2})^1 \times (P_{H_2})^3}$$

$$= \frac{3 \times 3}{1 \times 2 \times 2 \times 2} = \frac{9}{8}$$

$P_{NH_3} = \left(\frac{3}{6}\right) \times 6 = 3$ atm

$P_{N_2} = \frac{1}{6} \times 6 = 1$ atm

$P_{H_2} = \frac{2}{6} \times 6 = 2$ atm

Relation between Kp and Kc

$n_1 A_{(g)} \rightleftharpoons n_2 B_{(g)}$ (Balance rxn)

$K_c = \frac{[B]^{n_2}}{[A]^{n_1}}$

$K_p = \frac{(P_B)^{n_2}}{(P_A)^{n_1}} = \frac{[B]^{n_2}(RT)^{n_2}}{[A]^{n_1}(RT)^{n_1}}$

$K_p = \frac{[B]^{n_2}}{[A]^{n_1}} \times (RT)^{n_2 - n_1}$

$PV = nRT$

$P = \frac{n}{V} RT$

$P = [C] RT$

$P_A = [A] RT$

$P_B = [B] RT$

$$K_p = K_c \times (RT)^{\Delta n_g}$$

$\Delta n_g = n_2 - n_1$

CSD

$$K_p = K_c(RT)^{\Delta n_g} \quad \text{or} \quad \frac{K_p}{K_c} = (RT)^{\Delta n_g}$$

$\Delta n_g = 0$

$K_p = K_c$

Ex → $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

$\Delta n_g = 2 - (1+1) = 0$

$K_p = K_c$

$\Delta n_g > 0$, +ve

$RT > 1$

$K_p > K_c$

$\Delta n_g < 0$, −ve

$$K_p = \frac{K_c}{(RT)^{\Delta n_g}}$$

$K_p < K_c$

Q → $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

Calculate value of $\frac{K_p}{K_c}$ ratio

a) RT

~~b)~~ $(RT)^{-1}$

c) 0

d) $(RT)^{-2}$

$$\frac{K_p}{K_c} = (RT)^{\Delta n_g}$$

$$\Delta n_g = 2 - 2 - 1 = -1$$

$$\frac{K_p}{K_c} = (RT)^{-1}$$

Q9. In which of the following equilibrium K_c and K_p are not equal?

[CBSE AIPMT 2010]

(a) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$ $2-2=0$

(b) $SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$ $2-2=0$

(c) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ $2-2=0$

(d) $2C(s) + O_2(g) \rightleftharpoons 2CO_2(g)$ $2-1=+1$

$\Delta n_g \neq 0 \rightarrow K_p \neq K_c$

$\Delta n_g = 0 \rightarrow K_p = K_c$

Csd → Note → solid Reactant & product → Eq. Const Equation me nahi likhe Jate hai, Reason = solid R & P Ke Con = Constant hote hai

Ex → $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

$K_c = [CO_2]^1$

$K_p = (P_{CO_2})^1$

Q – $NH_4HS(s) \rightleftharpoons NH_3 + H_2S$
(g) (g)

K_p of rxn is ___

a) $P_{NH_3} \times P_{H_2S}$ //

b) P_{NH_3}

c) $[NH_3][H_2S]$

d) a & c both

Q17. For the equilibrium, $MgCO_3(s) \rightleftharpoons MgO(s) + CO_2(g)$ which of the following expressions is correct?

[CBSE AIPMT 2000]

(a) $K_p = p_{CO_2}$

(b) $K_p = \frac{[MgO][CO_2]}{[MgCO_3]}$

(c) $K_p = \frac{p_{MgO} \cdot p_{CO_2}}{p_{MgCO_3}}$

(d) $K_p = \frac{p_{MgO} + p_{CO_2}}{p_{MgCO_3}}$

Extent of dissociation and degree of dissociation

$$A \rightleftharpoons B$$

A_0	0	$t=0$
$A_0 - x$		at Eq.

Where → x = mole, Concentration, partial pressure

degree of dissociation (α)

$$\alpha = \frac{\text{Extent of dissociation}}{\text{Initial value of Reactant}}$$

or

$$\alpha = \frac{\text{dissociated Con. of Reactant}}{\text{Initial Con. of Reactant}}$$

Extent of dissociation = dissociated Con. of Reactant at Equilibrium

$= x \Rightarrow$ unit hogi

$$\alpha = \frac{x}{A_0}$$

α = unitless quantity

fraction of dissociation = α

Percentage of dissociation = $\alpha \times 100$

Q → $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$

10 mole of SO_3 initially present in close container, at Equilibrium, 4 mole of SO_3 dissociated.

$2SO_3 \rightleftharpoons 2SO_2 + O_2$

10 0 0 t=0

10-4 at Eq

Q-1 Extent of dissociation of SO_3 is

a) 10 b) 4 c) 6 d) $\frac{4}{10}$

Q-2 → degree of dissociation of SO_3

a) 10 b) 4 c) 6 d) $\frac{4}{10}$

$\alpha = \frac{4}{10}$, $100\alpha = 100 \times \frac{4}{10} = 40\%$

Q-3, Percentage of degree of dissociation → a) 2/5 b) 40% c) 60% d) NONE

Q-4 → total mole of gaseous mixture at Equilibrium

a) 10 mole   b) 14 mole   c) 12 mole ✓   d) NONE

$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$$

10	0	0	t=0
10-4	4 mole	2 mole	at Eq.

total mole = 6+4+2 = 12 mole

Q21. If α is the fraction of HI dissociated at equilibrium in the reaction, $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ starting with the 2 moles of HI, then the total number of moles of reactants and products at equilibrium are

[CBSE AIPMT 1996]

(a) $2 + 2\alpha$

(b) 2

(c) $1 + \alpha$

(d) $2 - \alpha$

2 mole = $2 \times \alpha$

$$2HI \rightleftharpoons H_2 + I_2$$

2 mole 0 0 t=0

$2-2\alpha$ α α at Eq

total = $2 - 2\alpha + \alpha + \alpha$ = 2 mole

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CHEMISTRY

chemical equilibrium

Lecture-03

Live → 7.00 pm → youtube

Smart Series

→ Atomic structure

→ Revision



Sarvesh Sir

Qsd-1

For the reaction, $SO_2(g) + \frac{1}{2}O_2(g)$ □ $\rightleftharpoons$ $SO_3(g)$, if $K_p = K_C\,(RT)^x$ where, the symbols have usual meaning, then the value of x is (assuming ideality)

(a) -1

(b) $-\frac{1}{2}$ ✓

(c) $\frac{1}{2}$

(d) 1

$K_p = K_C(RT)^{\Delta n_g}$

$\Delta n_g = x = ? \Rightarrow 1 - 1 - \frac{1}{2} = -\frac{1}{2}$

ARJUNA

Qsd-2

Q10. The dissociation constants for acetic acid and HCN at 25ºC are 1.5×10^{-5} and 4.5×10^{-10}, respectively. The equilibrium constant for the equilibrium,

$CN^- + CH_3COOH \rightleftharpoons HCN + CH_3COO^-$ would be

[CBSE AIPMT 2009]

(a) 3.0×10^5

(b) 3.0×10^{-5}

(c) 3.0×10^{-4}

(d) 3.0×10^4 ✓

$\frac{?}{2}$

① — $CH_3COOH \rightleftharpoons CH_3COO^- + H^+ \rightarrow 1.5 \times 10^{-5}$

$HCN \rightleftharpoons H^+ + CN^- \rightarrow 4.5 \times 10^{-10}$

② — $H^+ + CN^- \rightleftharpoons HCN \rightarrow \frac{1}{4.5 \times 10^{-10}}$

$CH_3COOH + CN^- \rightleftharpoons CH_3COO^- + HCN =$

$1.5 \times 10^{-5} \times \frac{1}{4.5 \times 10^{-10}}$ (4.5 → 3)

$\frac{10^5}{3} = \frac{10}{3} \times 10^4$

3.3×10^4

Calculation of Kc & Kp

Step-1 ⇒ Reaction balance hogi chahiye

Step-2 ⇒ initial state Ki value likho ($t=0$)

Step-3 ⇒ at Equilibrium pr value likho ($t=$ at Eq.)

Step-4 ⇒ Solve Question

$$K_{eq} = \frac{[\text{prd}]}{[\text{Reactant}]}$$

Q → $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

10 mole PCl_5 initial taken in 2 litre vessel, at Equilibrium 50% Rxn Complete. Calculate Eq. Const (K_c) of rxn.

a) 1.5×10^2

b) 1.7×10^4

c) 1.98

~~d)~~ NONE

$M = \frac{mole}{litre}$

PCl_5	$\rightleftharpoons PCl_3$	$+ Cl_2$	
10 mole	0	0	t=0
(10−5) mole	5 mole	5 mole	at Eq
$\frac{5\ mole}{2\ litre}$	$\frac{5\ mole}{2\ litre}$	$\frac{5\ mole}{2\ litre}$	

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$= \frac{(5/2)(5/2)}{(5/2)}$$

$K_c = \frac{5}{2}$ mole/litre

Q. In an experiment starting with 1 mole C2H5OH, 1 mole CH3COOH and 1 mole of water,
the equilibrium mixture on analysis shows that 54.3% of the acid is esterified.
Calculate Kc for the equilibrium reaction,

$C_2H_5OH + CH_3CO_2H \rightleftharpoons CH_3COOC_2H_5 + H_2O$

$A \rightleftharpoons B$

$\frac{n_1}{V} \qquad \frac{n_2}{V}$

1 1 0 1 t=0

(1-0.543) (1-0.543) 0.543mole (1+0.543)mole at Eq

0.457mole 0.457mole 0.543mole 1.543mole at Eq.

$K_{eq} = \frac{n_2/V}{n_1/V}$

$$K_c = \frac{(0.543)\times(1.543)}{(0.457)(0.457)}$$

In a chemical reaction, $A + 2B \overset{K}{\rightleftharpoons} 2C + D$, the initial concentration of B was 1.5 times of the concentration of A, but the equilibrium concentrations of A and B were found to be equal. The equilibrium constant chemical reaction is

[2019 Main, 12 Jan I]

$$K_{eq} = \frac{[C]^2[D]}{[A][B]^2} = \frac{(1)^2 \times 0.5}{(0.5)(0.5)^2} = \frac{100}{25} = 4$$

(a) 1/4
(b) 16
(c) 1
(d) 4 ✓

$$A + 2B \rightleftharpoons 2C + D$$

A	B	C	D	
1	1.5×1	0	0	t=0
1−x	1.5−2x	2x	x	at Eq
0.5	0.5	1	0.5	

$[A]_{Eq} = [B]_{Eq}$

$1 - x = 1.5 - 2x$

$x = 0.5$

Q → $PCl_5 (g) \rightleftharpoons PCl_3 (g) + Cl_2 (g)$

initial pressure of container is 100 mm of Hg, at Equilibrium the total pressure of container is 120 mm of Hg. Calculate Kp of rxn.

a) 80

b) 20

c) 160

~~d)~~ NONE

$K_p = \frac{(P_{PCl_3})^1 \times (P_{Cl_2})^1}{P_{PCl_5}}$

$= \frac{20 \times 20}{80}$

$K_p = 5$

PCl_5	$\rightleftharpoons$	PCl_3	+	Cl_2	
100		0		0	t=0
100-P		P		P	at Eq.
80mm		20mm		20mm	at Eq.

$P_T = P_{PCl_5} + P_{PCl_3} + P_{Cl_2}$

$120 = 100 - P + P + P$

P = 20 mm

Q → $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

at Equilibrium, the total pressure of Container is 10 mm of Hg

Calculate k_p of rxn

a) 10

b) 100

c) $\frac{1}{10}$

d) NONE

$P_T = 10\,mm$

$P_{CO_2} = 10\,mm$

$CaCO_3(s)$	$\rightleftharpoons$	$CaO(s)$	+	$CO_2(g)$	
0					t=0
0		0		P_{CO_2}	at Eq.

$$k_p = (P_{CO_2})^1 = 10\,mm$$

Q → $NH_4HS \rightleftharpoons NH_3(g) + H_2S(g)$

at Equilibrium, the total pressure of Container is 10 mm of Hg

Calculate Kp of rxn

$PV = nRT$

a) 10

b) 25 ✓

c) $\frac{1}{10}$

d) NONE

	$NH_4HS(s)$	$\rightleftharpoons NH_3(g)$	$+ H_2S(g)$	
	0	0	0	$t=0$
	0	P	P	at Eq.

$K_p = (P_{NH_3})^1 \times (P_{H_2S})^1$

$2P = 10,\ P = 5\text{ mm}$

$= 5 \times 5 = 25$

Q → $2SO_2 + O_2 \rightleftharpoons 2SO_3$, $K_p = 3.2$

at Equilibrium, pressure of SO_2 and SO_3 gas is equal than calculate partial pressure of O_2 gas at Equilibrium

a) 3.2

b) 3.2/2

c) 6

d) NONE

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

t=0

at Eq. $\quad P \quad P_{O_2} = ? \quad P$

$$K_p = \frac{(P_{SO_3})^2}{(P_{SO_2})^2 (P_{O_2})}, \quad P_{O_2} = \frac{1}{K_p} = \frac{1}{3.2}$$

Quatient Ratio

$A \rightleftharpoons B$

$Q_c = \frac{[B]}{[A]}$ any stage of reaction → 1, 2, 3, -- 5, 100, 200,

Quatient Ratio is equal to ratio of Con. of prd & Con. of Reactant at any stage of Reaction (1, 2, 5, 7, 100 Sec)

Q_c Ko hi Eq. Const Kaha jata hai, Equilibrium pr

($Q_c \rightarrow K_{eq}$)

Relation between Q_c and ΔG of rxn

$$\Delta G = \Delta G^0 + RT \ln Q_c \quad \text{—(1)}$$

at Equilibrium $\Delta G = 0$

$Q_c \rightarrow K_{eq}$

$$0 = \Delta G^0 + RT \ln K_{eq}$$

(2) → $\Delta G^0 = -RT \ln K_{eq}$

$\therefore \Delta G^0 = -2.3032\, RT \log K_{eq}$

1) $\log x = 0 \rightarrow x = 1$

2) $\log x = +ve,\ x > 1$

3) $\log x = -ve,\ x < 1$

Case-1: $\Delta G^0 = 0 \rightarrow K_{eq} = 1$

Case-2: $\Delta G^0 = -ve,\ K_{eq} > 1$

Case-3: $\Delta G^0 = +ve,\ K_{eq} < 1$

putting the value of ΔG° in Eq-1

$$\Delta G = -RT \ln K_{eq} + RT \ln Q_c$$

$$\Delta G = RT \ln \frac{Q_c}{K_{eq}}$$

$$\Delta G = +2.303\,2RT \log \frac{Q_c}{K_{eq}}$$

Case-1 $\Delta G = 0 \rightarrow$ at Equilibrium

$\frac{Q_c}{K_{eq}} = 1$, $Q_c = K_{eq}$

Case-2 $\Delta G = -ve \rightarrow$ spontaneous (forward direction)

$\frac{Q_c}{K_{eq}} < 1 \rightarrow Q_c < K_{eq}$

Case-3 $\Delta G = +ve$ (nonspontaneous backward direction)

$\frac{Q_c}{K_{eq}} > 1 \Rightarrow Q_c > K_{eq}$

CSD $\Delta G = \Delta G^\circ + RT \ln Q_c$

$\Delta G^\circ = -RT \ln K_{eq} = -2.303\,RT \log K_{eq}$

Case-1 → $\Delta G^\circ = 0$ → $K_{eq} = 1$

Case-2 → $\Delta G^\circ = -ve$, → $K_{eq} > 1$

Case-3 → $\Delta G^\circ = +ve$ → $K_{eq} < 1$

→ $$\Delta G = RT \ln \frac{Q_c}{K_{eq}} = 2.303\,RT \log \frac{Q_c}{K_{eq}}$$

Case-1 → $\Delta G = 0$ – at Eq. – $Q_c = K_{eq}$

Case-2 $\Delta G = -ve$ → spontaneous forward direction

$Q_c < K_{eq}$

Case-3 $\Delta G = +ve$ → nonspontaneous (backward direction)

$Q_c > K_{eq}$

The incorrect match in the following is [2019 Main, 12 April II]

(a) $\Delta G^\circ < 0, K > 1$ ✗

(b) $\Delta G^\circ = 0, K = 1$ ✗

(c) $\Delta G^\circ > 0, K < 1$ ✗

(d) $\Delta G^\circ < 0, K < 1$ ✓

$\Delta G^\circ = -RT \ln K_{eq}$

Q → $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ → $K_{eq} = 10$

After 2 minute the Con. of PCl_5, PCl_3 & Cl_2 is 2M, 3M, 4M respectively. findout direction of rxn

a) forward ✓

b) backward

c) Equilibrium

d) Can not say

$$Q_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{3 \times 4}{2} = 6$$

$Q_c < K_{eq}$ → forward directn

Q → $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ → $K_{eq} = 10$

After 2 minute the Con. of PCl_5, PCl_3 & Cl_2 is 0.2M, 0.1M, 2M respectively. findout direction of rxn

a) forward

b) backward

c) Equilibrium

d) Can not say

2 Oct = 8.30 am

extra class hai

Live hai

13:3

Test Ka syllabus → Chemical Equilibrium

MANTHAN NEET 2025

CHEMISTRY

chemical equilibrium

Lecture-04

3Oct - Live = 7 pm
You-tube

Mole Concept → Smart Series



Sarvesh Sir

In which one of the following equilibria, $K_p \neq K_c$? [2019 Main, 12 April II]

(a) $2C(s) + O_2(g) \rightleftharpoons 2CO(g)$ → 2−1 = 1 ✓

(b) $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ → $\Delta n_g = 0$ ✗

(c) $NO_2(g) + SO_2(g) \rightleftharpoons NO(g) + SO_3(g)$ − $\Delta n_g = 0$ ✗

(d) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$

$\Delta n_g = 0$

$\Delta n_g = 0 \rightarrow K_c = K_p$

$\Delta n_g \neq 0 \rightarrow K_p \neq K_c$

Q15. The reaction quotient (Q) for the reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is given by $Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$ The reaction will proceed towards right side, if

[CBSE AIPMT 2003]

(a) $Q > K_c$ → back

(b) $Q = 0$

(c) $Q = K_c$ → Eq.

(d) $Q < K_c$

forward direction

$\frac{?}{2}$

Le-chatelier's prp^r

If a reaction present in Equilibrium, Change any variable (Concentration, temp & pressure etc than Equilibrium shifted that direction, the effect of change neglect

Ex→ $A \rightleftharpoons B$, $\Delta H = -50 KJ$ at Eq.

Con. of A = increase, Equilibrium shifted that direction

Con of A decreases, So reach old Eq

Csp

OPPOSITE KAM KARNA Hai

Only rxn Ki direction change Kr sakte hai

1) Effect of Concentration

Con. of Reactant = increase → forward direction

Con. of Reactant = decrease → backward direction

Con. of product = increase → backward direction

Con. of product = decrease → forward direction

Q $N_2 + 3H_2 \rightleftharpoons 2NH_3$

If the Con. of NH_3 decreases 20%, than Reaction occurs ____

a) forward direction   forward direction

b) backward

c) at Equilibrium

d) Can not say

2) Effect of pressure

$$PV = nRT$$

$$P \propto n$$

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

4 mole — 2 mole

Pressure = increase → Equilibrium shifted less No. of gaseous mole of Reactant / product

Pressure = decrease → Equilibrium shifted greater No. of gaseous mole of Reactant / product

Note → $\Delta n_g = 0$ → No Effect of pressure

Q → $PCl_5 \rightleftharpoons PCl_3 + Cl_2$, the pressure system increases than Equilibrium Shifted ____

a) forward

b) backward ✓

c) No effect of pressure

d) Can not say

Q → $_NO + _SO_3 \rightleftharpoons _NO_2 + _SO_2$

$\Delta n_g = 0$

Pressure ↑ - increases

a) forward b) backward

c) at Equilibrium ✓

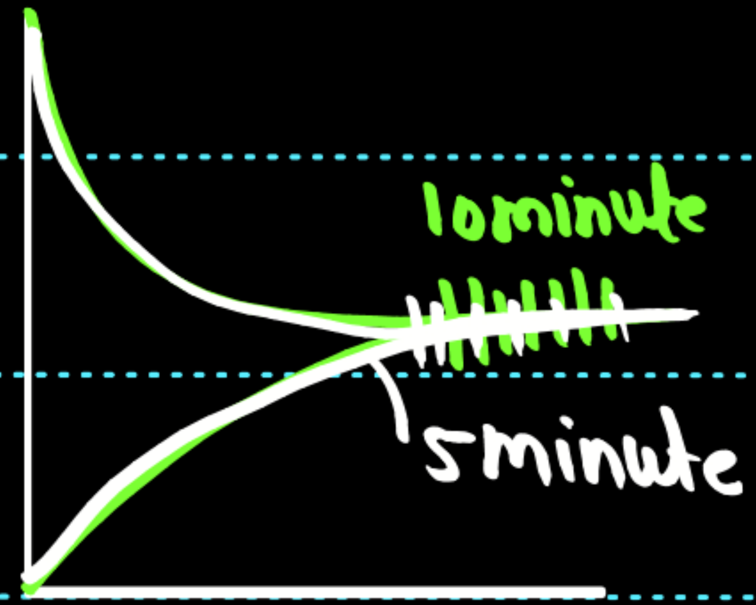
d) Can not say

3) Effect of Catalyst

→ No effect in Equilibrium

→ Only increase Rate of forward and backward reaction

→ Equilibrium reach before time



→ NO participate in chemical rxn ⇒ Con of Catalyst = same

4) Effect of inert Gas

- inert gas not participate in Chemical reaction
- total mole of gas mixture = increase

- $\Delta n_g = 0$, → NO effect of inert gas
- At Constant volume = No effect of inert gas

$$PV = nRT \Rightarrow V = \left(\frac{n}{P}\right) RT$$

→ **At Constant pressure with**

$\Delta n_g \neq 0$ = Effect hota hai

→ Eq. Const = No effect

$$n_1 A \rightleftharpoons n_2 B$$

$$K_p = \frac{(P_B)^{n_2}}{(P_A)^{n_1}} = \frac{(X_B \cdot P_T)^{n_2}}{(X_A \cdot P_T)^{n_1}}$$

$$K_p = \frac{(n_B/n_T)^{n_2}}{(n_A/n_T)^{n_1}} \times (P_T)^{n_2 - n_1}$$

$$K_p = \frac{\left(\frac{n_B}{n_T}\right)^{n_2}}{\left(\frac{n_A}{n_T}\right)^{n_1}} \times (P_T)^{n_2-n_1} \Rightarrow$$

$$x = \frac{1}{x^{-1}}$$

$$K_p = \frac{(n_B)^{n_2}}{(n_A)^{n_1}} \times \frac{(n_T)^{n_1}}{(n_T)^{n_2}} \times (P_T)^{n_2-n_1}$$

$$K_p = \frac{(n_B)^{n_2} \times (n_T)^{n_1-n_2} \times (P_T)^{n_2-n_1}}{(n_A)^{n_1}} = \frac{(n_B)^{n_2}}{(n_A)^{n_1}} \times \frac{(P_T)^{n_2-n_1}}{(n_T)^{n_2-n_1}}$$

$$\boxed{K_p = \frac{(n_B)^{n_2}}{(n_A)^{n_1}} \times \left(\frac{P_T}{n_T}\right)^{\Delta n_g}}$$

$$K_p \propto \left(\frac{1}{n_T}\right)^{\Delta n_g}$$

$$K_p = \frac{[prd]}{[Reactant]}$$

$\Delta n_g = +ve$ or $\Delta n_g > 0 \rightarrow \downarrow K_p \propto \frac{1}{n_T \uparrow} \rightarrow$ forward direction

$\Delta n_g = -ve$ or $\Delta n_g < 0 \rightarrow \uparrow K_p \propto (\uparrow n_T)^{\Delta n_g} \rightarrow$ backward direction

inert gas

at Const volume	$\Delta n_g = 0$	at Const pressure + $\Delta n_g \neq 0$
No effect	No effect	$K_p \propto \left(\frac{1}{n_T}\right)^{\Delta n_g}$

→ $\Delta n_g = +ve$ → forward directⁿ

→ $\Delta n_g = -ve$ → backward directⁿ

Q → $N_2 + 3H_2 \rightleftharpoons 2NH_3$

If 2 mole of He gas involving in container, than Equilbm Shifted at Const pressure

$\Delta n_g = 2-4 = -2$

a) forward

b) backword ✓

c) No effect

d) Can not say

Q → $N_2 + 3H_2 \rightleftharpoons 2NH_3$

If 2mole of He gas involving in container, than Equilb^m shifted at Const Volume

a) forward

b) backward

c) No effect //

d) Can not say

13:3

5) Effect of temperature

$$n_1 A \rightleftharpoons n_2 B, \quad \Delta H = -ve \ (exo)$$

temperature = increase = Rxn shifted endothermic side

temperature = decrease = Rxn shifted exothermic side

Q → $N_2 + 3H_2 \rightleftharpoons 2NH_3$, $\Delta H = -ve$

L → R → −ve
R → L → +ve

temp. of sys. increase

a) forward   b) backward ✓

c) at Eq.   d) Can not say

Effect of temp in Equilibrium Constant

T_1K temp $\longrightarrow K_1$

T_2K temp $\longrightarrow K_2$

$T_2 > T_1$

***
$$2.3032 \log \frac{K_2}{K_1} = \frac{\Delta H}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

***
$$\ln \frac{K_2}{K_1} = \frac{\Delta H}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

Case-1 $\Delta H = 0$

$\frac{K_2}{K_1} = 1 \rightarrow \boxed{K_1 = K_2}$

No effect of temp

Case-II $\rightarrow \Delta H = +ve$ (endo)

$\frac{K_2}{K_1} > 1$, $K_2 > K_1$

forward direction

Case-3 $\Delta H = -ve$ (exo)

$\frac{K_2}{K_1} < 1$, $K_2 < K_1$

backward direction

Q11. If the concentration of OH^- ions in the reaction $Fe(OH)_3(s) \rightleftharpoons Fe^{3+}(aq) + 3OH^-(aq)$ decreased by ¼ times, then equilibrium concentration of Fe^{3+} will increase by

[CBSE AIPMT 2008]

(a) 8 times

(b) 16 times

(c) 64 times

(d) 4 times

Q22. The rate constants for forward and backward reaction of hydrolysis of ester are 1.1×10^{-2} and 1.5×10^{-3} per minute. Equilibrium constant for the reaction $CH_3COOC_2H_5 + H^+ \rightleftharpoons CH_3COOH + C_2H_5OH$ is

[CBSE AIPMT 1995]

(a) 4.33 (b) 5.33

(c) 6.33 (d) 7.33

Q. At 2800 K, a 1.0 mole sample of CO_2 in a one litre container is 50% decomposed to carbon monoxide and oxygen at equilibrium $2CO_2(g) \quad 2CO(g) + O_2(g)$ The value of K_c for the reaction is –

(a) 0.25

(b) 0.50

(c) 50

(d) 25

Q2. . If the value of an equilibrium constant for a particular reaction is 1.6×10^{12}, then at equilibrium the system will contain

[CBSE AIPMT 2015]

(a) all reactants

(b) mostly reactants

(c) mostly products

(d) similar amounts of reactants and products

For the chemical reaction, $3X(g) + Y(g) \rightleftharpoons X_3Y(g)$ the amount of X_3Y at equilibrium is affected by

$\Delta n_g \neq 0$

[1999, 2M]

(a) Temperature and pressure ✓

(b) temperature only ✗

(c) Pressure only ✗

(d) temperature, pressure and catalyst ✗

For the reaction, $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$, at a given temperature, the equilibrium amount of $CO_2(g)$ can be increased by

[1998]

(a) Adding a suitable catalyst

(b) Adding an inert gas

(c) Decreasing the volume of the container

(d) Increasing the amount of $CO(g)$

For the reaction, $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ the forward reaction at constant temperature is favoured by: **[1991, 1M]**

$\Delta n_g = 2 - 1 = +1$

(a) Introducing an inert gas at constant volume ✗

(b) Introducing chlorine gas at constant volume ✗

(c) Introducing an inert gas at constant pressure ✓ → $\Delta n_g \neq 0$

$\Delta n_g = +ve$ → forward

$\Delta n_g = -ve$ backward

(d) Increasing the volume of the container ✓

(e) Introducing PCl_5 at constant volume ✓

(c, d, e)

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$\downarrow K_c = \frac{\text{Mole}}{\text{Volume}\uparrow}$$

The equilibrium $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$ is attained at 25°C in a closed container and in inert gas, helium is introduced. Which of the following statements are correct? [1989, 1M]

(a) Concentration of SO_2, Cl_2 and SO_2Cl_2 change

(b) More chlorine is formed

(c) Concentration of SO_2 is reduced

(d) None of the above

SANKALP NEET VEDANTU

MANTHAN NEET 2025

CHEMISTRY

Ionic equilibrium

Lecture-01

Monday & tuesday

Ionic → 8:30 pm

Ionic → 1:15 pm



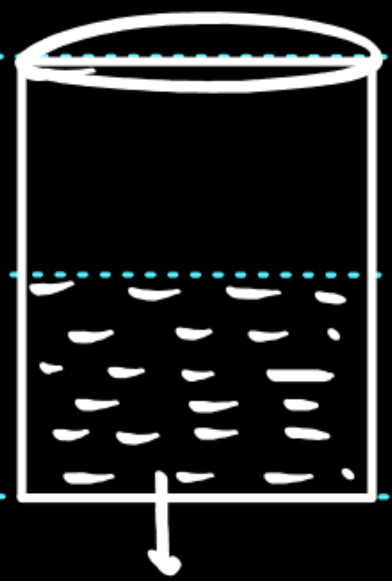
Sarvesh Sir

Electrolyte

$NaCl(s) \rightarrow Na^{+}(aq) + Cl^{-}(aq)$

$HCl \rightarrow H^{+} + Cl^{-}$

$H_2O \rightleftharpoons H^{+} + OH^{-}$ (self ionisation)



Solution or solvent

those solvent or solution called **electrolyte**, which is given ions in solution or solvent

Non-electrolyte = not given ions in solution or solvent

Ex glucose sol^n = nonelectrolyte

Ex Benzene solvent = nonelectrolyte

Q → select Electrolyte solution in given example

a) Urea sol^n $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

b) Sucrose sol^n

c) Benzene liquid

d) CH_3COOH sol^n ✓

Classification of electrolyte

Electrolyte → ions deta hai

- **Weak electrolyte**
  - → very poor ionisation
  - → 2%, 3%, 5%, 10%, 20%
  - Ex → W.A, W.B,
- **Strong electrolyte**
  - → 100% ionisation
  - → approx 100%
  - → S.A, S.B, Salt

Q → Select weak electrolyte sol^n

a) NaCl sol^n ✗

b) NaOH sol^n ✗

c) –COOH sol^n ✓✓

d) HCl sol^n ✗

Acid-Base Concept

Arrehinus Acid-Base Concept

Acid = those subs. called Acid, which gives H^+ (Hydrogen ion) in solution

Base = those subs. is called Base, which is given OH^- (Hydroxyl ion) in solution.

Ex → $HCl \rightarrow H^+ + Cl^-$ Ex → $NaOH \rightarrow Na^+ + OH^-$

Ex → $CH_3COOH \rightarrow H^+ + CH_3COO^-$ Ex → $NH_3 + H_2O \rightarrow NH_4OH \rightarrow NH_4^+ + OH^-$

Q → $H_3A \rightleftharpoons H^+ + H_2A^-$

H_3A is a

a) Acid ✓

B) Base

c) Can not say

$HCl + NaOH \rightarrow NaCl + H_2O$

$HCl \rightarrow H^+ \; Cl^-$, $NaOH \rightarrow Na^+ \; OH^-$, $NaCl \rightarrow Na^+Cl^-$

$H^+ \; Cl^- \; Na^+ \; OH^- \rightarrow H-OH$

Note → H^+ & OH^- does not exist in solution, exist only hydrated form

$H^+(H_2O)_x$ → hydrated

$OH^-(H_2O)_x$ → hydrated

$x=1 \rightarrow H_3O^+$, $x=2 \rightarrow H_5O_2^+$

$x=1$, $H_3O_2^-$

Q → which type of ions exist in solution

a) H_3O^+ ✓ $H^+(H_2O)_x$ → $x = 1, 2, 3, 4 \ldots$

b) $H_5O_2^+$ ✓ H_3O^+, $H_5O_2^+$

c) $H_4O_2^+$ ✗

d) A & B both ✓✓

e) All

Bronsted-Lowery Concept

Bronsted-Lowery Acid = H^+ donar

Bronsted-Lowery Base = H^+ acceptor

Ex→ $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

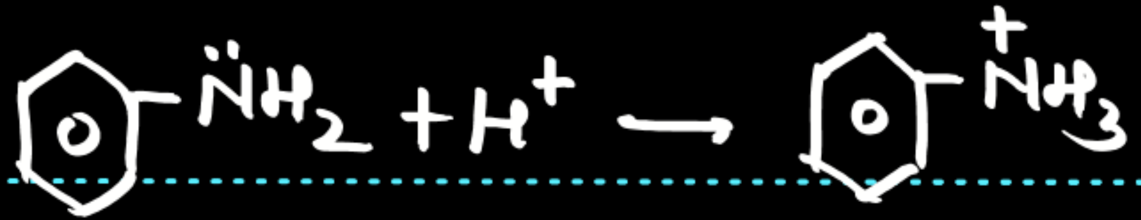
Acid.

$HCN \rightleftharpoons H^+ + CN^-$

Acid

$\ddot{N}H_3 + H^+ \rightleftharpoons \overset{+}{N}H_4$

Base



Base

$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$

Acid — Conjugate base

$HCN + H_2O \rightleftharpoons CN^- + H_3O^+$

Acid — Conj. Base

$\ddot{N}H_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

Base — Conjugate Acid

Acid $- H^+$ = Conjugate Base → Acid, Conj. Bas = Conj. Acid-Base pair
(Base $+ H^+$ = Conjugate Acid → Base-Conj. Acid pair

Q → Select Conjugate Base of HNO_3

a) NO_3^-

b) HNO_3

c) $H_2NO_3^+$

d) NO_2^-

$$HNO_3 \rightarrow H^+ + NO_3^-$$

Acid — Conj. Base

Problem 7.12

What will be the conjugate bases for the following Brönsted acids: HF, H_2SO_4 and HCO_3^-? → CO_3^{-2}

F^- HSO_4^-

Problem 7.15

Classify the following species into Lewis acids and Lewis bases and show how these act as such:

(a) HO^- (b) F^- (c) H^+ (d) BCl_3

i → B

ii → e

iii → C

(iv) → d

41. Match the following species with the corresponding conjugate acid

Species		Conjugate acid
(i)	NH_3 → NH_4^+	(a) CO_3^{2-}
(ii)	HCO_3^- → H_2CO_3	(b) NH_4^+
(iii)	H_2O → H_3O^+	(c) H_3O^+
(iv)	HSO_4^- → H_2SO_4	(d) H_2SO_4
		(e) H_2CO_3

Base + H^+ = Conj. Acid

Problem 7.14

The species: H_2O, HCO_3^-, HSO_4^- and NH_3 can act both as Bronsted acids and bases. For each case give the corresponding conjugate acid and conjugate base.

$$H_2O \rightleftharpoons H^+ + OH^-$$

H_2O → Acid; OH^- → Conj. Base

$$H_2O + H^+ \rightleftharpoons H_3O^+$$

H_2O → Base; H_3O^+ → Conj. Acid

$$HCO_3^- + H^+ \rightleftharpoons H_2CO_3$$

HCO_3^- → Base; H_2CO_3 → Conj. Acid

$$HCO_3^- \rightarrow CO_3^- + H^+$$

HCO_3^- → Acid; CO_3^- → Conj. Base

Q → Select Conj. Base of $\ddot{N}H_3$

a) $\overset{+}{N}H_4$

b) NH_2^- ✓

c) $\ddot{N}H_3$

d) NONE

$\ddot{N}H_3 \longrightarrow H^+ + \boxed{NH_2^-}$

Acid — Conj. Base

$\ddot{N}H_3 + H^+ \rightleftharpoons NH_4^+$

Conj. Acid

Lewis Acid-Base

Lewis Acid = lone pair Acceptor (e^--difficient + octet incomplete)

Lewis Base = lone pair donar (min. 1 e^- pair + octet complete)

lone pair = e^- pair = nonbonded e^- pair (··)

Cl^- = ?

1) L·A

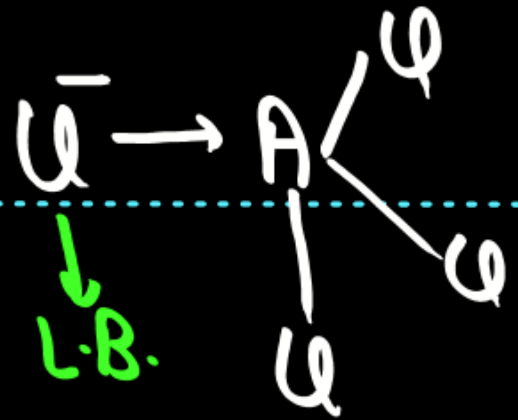
2) L·B

$H_3N: + BF_3 \longrightarrow H_3N:\rightarrow BF_3$ (Adduct)

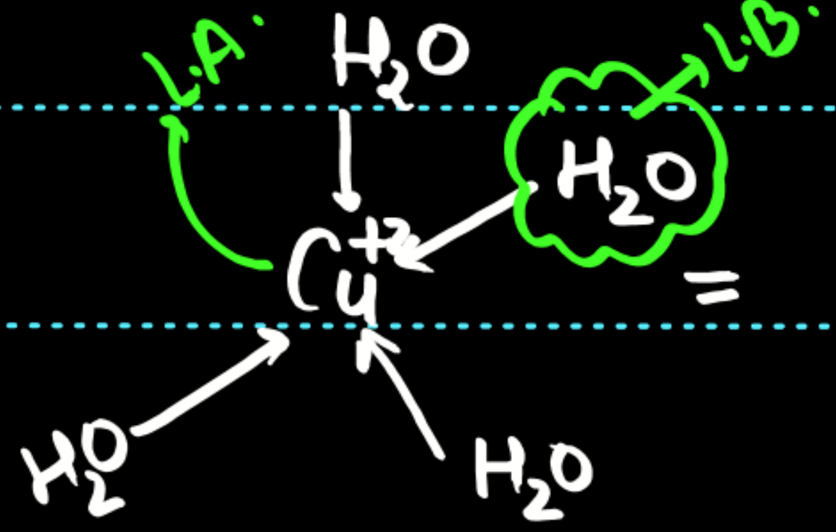
H_3N ↓ L·B. BF_3 ↓ L·A.

$Cl^- + AlCl_3 \longrightarrow$

Cl^- = L·B, $AlCl_3$ = L·A



Q → Select Correct option $\quad Cu^{+2} \leftarrow$



$= [Cu(H_2O)_4]^{+2}$

a) $Cu^{+2} \rightarrow$ L.A. ✓✓

b) $H_2O \rightarrow$ L.B. ✓✓

c) $H_2O \rightarrow$ L.A.

d) $H_2O -$ L.B

e) A & B both Correct ✓✓

thermodynamics & thermochemistry

SMART RI → 50 Question

Statements

Matching

A&R →

7:00 pm → LIVE → you tube

CSD → Revision

NOTE Book → Revision

CSD Electrolyte = having ions in solution | solvent

Nonelectrolyte = not present ions in solution | solvent

Weak electrolyte = very poor ionisation (W·A, W·B)

Strong electrolyte = approx 100% ionisat^n (S·A, S·B, salt)

Arrehinus Acid = given H^+ in aq. sol^n

Arrehinus Base = given OH^- in aq. sol^n

Note → H^+ and OH^- - exist only hydrated form in sol^n

$H^+(H_2O)_x$, $OH^-(H_2O)_x$

Bronsted-Lowery Acid

→ H^+ donar

Bronsted-Lowery Base

→ H^+ Acceptor

→ Acid − H^+ = Conj. Base

→ Base + H^+ = Conj. Acid

→ Lewis Acid = l.p. Acceptor

→ Lewis Base = l.p. donar

Q5. Which of the following fluoro-compounds is most likely to behave as a Lewis base? → l.p. donar

[NEET 2016, PHASE-II]

(a) BF_3 → ✗

(b) PF_3 → $\ddot{P}F_3$

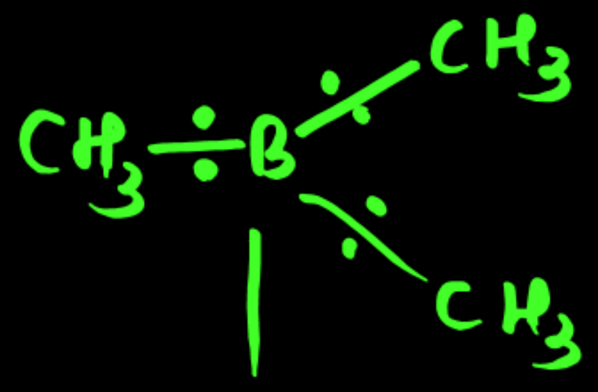
(c) CF_4 → ✗

(d) SiF_4 → ✗

Q22. Which of the following molecules acts as a Lewis acid?

[CBSE AIPMT 2009]

(a) $(CH_3)_3B$ ✓ →



6e⁻ – incomplete

lone pair Accept

e⁻ difficient

(b) $(CH_3)_2\ddot{O}$ → ✗

(c) $(CH_3)_3\ddot{P}$ → ✗

(d) $(CH_3)_3\ddot{N}$ → ✗

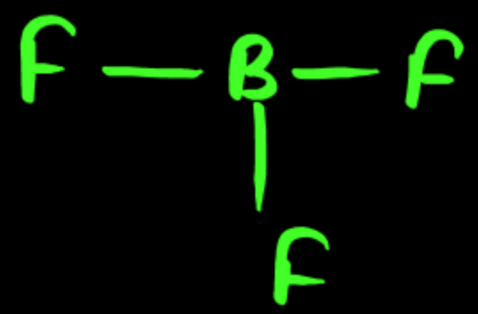
Q11. Which of these is least likely to act as a Lewis base? **[NEET 2013]**

Lewis acid = ?

(a) CO

(b) F^-

(c) BF_3 →



(d) PF_3

Q12. Which of the following is electron deficient? [NEET 2013]

(a) $(CH_3)_2$ → CH_3-CH_3

(b) $(SiH_3)_2$ → SiH_3-SiH_3

(c) $(BH_3)_2$ → B_2H_6

(d) $\ddot{P}H_3$

SANKALP NEET VEDANTU

MANTHAN NEET 2025

7.00 pm → live → youtube → Aaj

CHEMISTRY

One shot SMART SERIES
↓
Thermodynamic

8.30 am
1.00 pm → tuesday

Ionic equilibrium

Lecture-02



Sarvesh Sir

CSD Electrolyte = having ions in solution | solvent

Nonelectrolyte = not present ions in solution | solvent

Weak electrolyte = very poor ionisation (W·A, W·B)

Strong electrolyte = approx 100% ionisat^n (S·A, S·B, Salt)

Arrehinus Acid = given H^+ in aq. sol^n

Arrehinus Base = given OH^- in aq. sol^n

Note → H^+ and OH^- - exist only hydrated form in sol^n

$H^+(H_2O)_x$, $OH^-(H_2O)_x$

Bronsted-Lowery Acid

→ H^+ donar

Bronsted-Lowery Base

→ H^+ Acceptor

→ Acid − H^+ = Conj. Base

→ Base + H^+ = Conj. Acid

→ Lewis Acid = l.p. Acceptor

→ Lewis Base = l.p. donar

Dissociation Constant of weak acid & weak base

$CH_3COOH \rightleftharpoons H^+ + CH_3COO^-$

Molecule and its aqueous ion → Equilb^m

$K_{eq} = \frac{[H^+][CH_3COO^-]}{[CH_3COOH]}$

↓

$K_a = \frac{[H^+][CH_3COO^-]}{[CH_3COOH]}$

↓

dissociation Const of weak Acid

$NH_4OH \rightleftharpoons NH_4^+ + OH^-$

$K_{eq} = \frac{[NH_4^+][OH^-]}{[NH_4OH]}$

↓

$K_b = \frac{[NH_4^+][OH^-]}{[NH_4OH]}$

↓

dissociation Const of weak base

Q – Ka of weak acid HCN is 1.7×10^{-8}

$HCN \rightleftharpoons H^+ + CN^-$

If the concentration of CN^- ion increases 10 times. than new dissociation const is

Ka is a Equilibrium const

So value of Ka only depend upon temp.

a) $Ka > 1.7 \times 10^{-8}$

b) $Ka < 1.7 \times 10^{-8}$

c) $Ka = 1.7 \times 10^{-8}$ ✓

d) NONE

Ionic product of water

water = universal solvent

$$H_2O \rightleftharpoons H^+ + OH^- , \Delta H = +ve (endo)$$

very poor ionisation = weak electrolyte

$$K_{eq} = \frac{[H^+][OH^-]}{[H_2O]}$$

$$K_{eq} \times [H_2O] = [H^+][OH^-]$$

K_w = Ionic product of watter

$$K_w = [H^+][OH^-]$$

$$K_w = K_{eq} \times [H_2O]$$

$$K_w = K_{eq} \times 55.55$$

$$K_{eq} = \frac{K_w}{55.55}$$

$K_w = 1 \times 10^{-14}$ at 298K or 25°C

$K_w \propto$ temperature

↳ Eq. Shifted forward

$$K_w = 10^{-14} = [H^+] \times [OH^-] \text{ at } 25^\circ C$$

$$K_w = 10^{-14} = [H^+]^2 \text{ or } [OH^-]^2 \text{ at } 25^\circ C \quad (\because [H^+] = [OH^-])$$

$$\boxed{[H^+] = [OH^-] = \sqrt{K_w} = \sqrt{10^{-14}} = 10^{-7}}$$ → at $25^\circ C$ → Standard Condition

$d = 1 \frac{gram}{ml}$

1ml = 1gram H_2O hai

$$\text{Molarity of } H_2O = \frac{n_{H_2O}}{(Vol.)_{H_2O}}$$

$$= \frac{(1/18)}{1/1000} = \frac{1000}{18} = \frac{500}{9} = 55.55$$

Q → Kw of water = 1×10^{-14} at 25°C, If the temp. of water increase 100°C than Kw value is

a) $Kw = 10^{-14}$

b) $Kw > 10^{-14}$ ✓

c) $Kw < 10^{-14}$

d) NONE

Kw ∝ temp.

Q → Kw of water at 90°C is 10^{-12}, than select Correct option for water (more than one Ans. Correct)

a) ✗ $[H^+] = 10^{-7}$

b) ✓ $[H^+] = 10^{-6}$

c) ✗ $[H^+] = [OH^-] = 10^{-7}$

d) ✓ Water is neutral at 90°C temp.

$K_w = 10^{-12}$

$[H^+] = [OH^-] = \sqrt{K_w} = \sqrt{10^{-12}} = 10^{-6}$

Relation between Ka of weak acid and Kb' of its conjugate base

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

W.A. Conj. Base

W.A − H^+ = Anion (Conj. Base of W.A.)

W.A ⇌ Anion + H^+

W.A ⇌ Conj. Base + H^+

W.A Conj. Base

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+ = K_a \quad \text{— (1)}$$

$$CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^- \quad \text{— (2)} \rightarrow K_b$$

Conj. Base

(1) + (2)

$$H_2O \rightleftharpoons H^+ + OH^- \rightarrow K_w = ?$$

$$K_w = K_a \times K_b$$

Q → $CH_3COOH \rightleftharpoons CH_3COO^- + H^+ \rightarrow K_a = 10^{-5}$

(Conj. Base under CH_3COO^-)

$CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^- \rightarrow K_b = ?$

Conj. Base

$(K_a)_{CH_3COOH} \times (K_b)_{CH_3COO^-} = 10^{-14}$

~~a)~~ 10^{-9}

b) 10^{-5}

c) 10^{-14}

d) 10^{-8}

$10^{-5} \times K_b = 10^{-14}$

$K_b = \frac{10^{-14}}{10^{-5}} = 10^{-14+5} = 10^{-9}$

13:3

Q → $HF \rightleftharpoons H^+ + F^-$ → $K_a = 10^{-4}$

(conj. Base)

Calculate dissociation Const of given rxn

$$F^- + H_2O \rightleftharpoons HF + OH^- \rightarrow K_b = ?$$

a) 10^{-4}

b) 10^{-10}

c) 10^{-14}

d) 10^{-8}

$K_a \times K_b = 10^{-14}$

$10^{-4} \times K_b = 10^{-14}$

$K_b = 10^{-10}$

Q → $NH_4OH \rightleftharpoons NH_4^+ + OH^-$

W.B. Conj. Acid

Q → Conjugate acid of W.B (NH_4OH)

a) OH^-

b) NH_4^+ ✓✓

c) NH_4OH

d) All

W.B

Q → $NH_4OH \rightleftharpoons NH_4^+ + OH^- \rightarrow K_b = 10^{-6}$

Conj. Acid

$NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+ \rightarrow K_a = ?$

Conj. Acid

a) 10^{-6}

b) 10^{-8} ✓

c) 10^{-10}

d) 10^{-9}

$K_b \times K_a = 10^{-14}$

$10^{-6} \times K_a = 10^{-14}$

$K_a = 10^{-8}$

pH scale

→ pH scale measure → Potential of H^+ Concentration of solution

→ pH scale measure ⇒ Acidic strength of sol^n.

$$pH = -\log[H^+]_{solution}$$

$$[H^+]_{sol^n} = [H^+]_{Acid} + [H^+]_{H_2O}$$

$$[H^+]_{sol^n} = [H^+]_{Acid} + 10^{-7}$$

$$pH = -\log[H^+_A + 10^{-7}]$$

$H_xA \rightarrow S.A \Rightarrow M$

$[H^+]_A = x \times M$

10^{-4} M H_2SO_4

$[H^+] = 2\times10^{-4}$ M

10^{-4} M H_3A (S.A).

$[H^+] = ? = 3\times10^{-4}$

a) 10^{-4} b) 3×10^{-4} ✓

c) 2×10^{-4} d) NONE

Q-1 → 10^{-3} M HCl solution → pH = ?

a) 3 ✓ b) 4 c) 3.4 d) 2.6

$$pH = -\log[H^+_A + 10^{-7}]$$

$$H^+_A = 1\times10^{-3} = 10^{-3}\,M$$

$[H^+]_A > 10^{-6}$, $pH = -\log[H^+_A]$

$$pH = -\log 10^{-3}$$

$$pH = -(-3)\log 10$$

$$(pH = 3)$$

Q → 10^{-5} M HNO_3, pH = ?

a) 5

b) 4.8

c) 5.8

d) 9

$H^+_A = 1 \times 10^{-5} = 10^{-5}$

$pH = -\log H^+_A$

$= -\log 10^{-5}$

$\boxed{pH = 5}$

$$pH = -\log(10^{-3} + 10^{-7})$$

$$= -\log(10000 \times 10^{-7} + 10^{-7})$$

$$= -\log(10001 \times 10^{-7})$$

$$-\log 1.0001 \times 10^{-3}$$

$$-\log 1.0001 - \log 10^{-3}$$

$$-\log 1.0001 + 3$$

$$pH = 3 - \log 1.0001$$

13:3

CSD → K_a, K_b → Equilb^m Constant

→ K_a & K_b → only depend upon temp.

→ $H_2O \rightleftharpoons H^+ + OH^-$, $\Delta H = +ve$

→ $K_{eq} = \frac{[H^+][OH^-]}{[H_2O]}$

→ $K_w = [H^+][OH^-]$

→ $K_w = K_{eq} \times [H_2O]$

$$K_{eq} = \frac{K_w}{55.55} = \frac{10^{-14}}{55.55}$$

$K_w = 10^{-14}$ at 25°C or 298K

$$K_w \propto \text{temperature}$$

$[H^+] = [OH^-] = \sqrt{K_w}$

at 25°C → $[H^+] = [OH^-] = \sqrt{10^{-14}} = 10^{-7}$

→ $(K_a)_{W.A} \times (K_b)_{Conj.\,Base} = K_w = 10^{-14}$

→ $(K_b)_{W.B} \times (K_a)_{Conj.\,Acid} = K_w = 10^{-14}$

C_{SD} $pH = -\log[H^+_A + 10^{-7}]$ → universal formula.

$M\ H_x A \rightarrow [H^+]_A = x \times M$

Case → Calculation ko easy krne

Ke liye, ek 'approximation' lete hai

$[H^+]_A > 10^{-6} \Rightarrow$ $\boxed{pH \approx -\log[H^+]_A}$

$(\because H^+_A + 10^{-7} \approx H^+_A)$

MANTHAN NEET 2025

CHEMISTRY

Ionic equilibrium

Lecture-03

1:00 pm → 2nd class



Sarvesh Sir

Qsd-1 Select Correct match

List-1	List-2
✗ a) Electrolyte	p) sucrose
✗ b) Nonelectrolyte	q) NaCl soln
✗ c) Strong electrolyte	r) HCN soln
✓ d) weak electrolyte	s) CH_3COOH soln

Qsd-2 Conjugate base of HCN

a) H^+

b) CN^- ✓

c) HCN

d) CN^+

$HCN \longrightarrow H^+ + CN^-$

CN^- ↓ Conj. Base

$\frac{?}{2}$

pH of strong acid

a) 10^{-4} M HCl solⁿ.

~~a)~~ 4

b) 3.8

c) 4.2

d) NONE

$[H^+]_A = 1 \times 10^{-4} = 10^{-4}$ M

$pH = -\log 10^{-4}$

$pH = +4 \log 10 = +4$

$pH = -\log(H^+_A + 10^{-7})$

$H^+_A > 10^{-6} \Rightarrow pH \approx -\log H^+_A$

Q → 10^{-4} M H_2SO_4 solⁿ

a) 4

b) 4 − log 2 ✓

c) 4 + log 2

d) NONE

$[H^+] = 2\times10^{-4}$

$pH = -\log 2\times10^{-4} = 4 - \log 2$

$= -\log 2 - \log 10^{-4}$

$= -\log 2 + 4\log 10$

$pH = 4 - \log 2$

13:3

Q → 10^{-8} M HCl solⁿ, pH = ?

$pH = 8$

X a) 8

$[H^+] = 1\times10^{-8} = 10^{-8}$

$pH > 7 \rightarrow$ Basic solⁿ

b) 6

$pH = -\log(H^+_A + 10^{-7})$

c) 6.99 //

$pH = -\log(10^{-8} + 10^{-7})$

X d) 7.2

$pH = -\log(10^{-8} + 10\times10^{-8}) = -\log(1+10)\times10^{-8}$

$= -\log 11\times10^{-8} = -\log 1.1\times10^{-7}$

$pH = 7 - \log 1.1 \simeq 6.998$

Q → 10^{-10} M HNO_3 solⁿ, pH = ?

a) 10

b) 10 − log 1.1

c) 7 − log 1.001 ✓

d) NONE

$H^+_A = 1\times10^{-10} = 10^{-10}$ M

$pH = -\log(10^{-10} + 10^{-7})$

$pH = -\log(10^{-10} + 1000\times10^{-10})$

$= -\log(1+1000)\times10^{-10}$

$= -\log 1001\times10^{-10} = -\log 1.001\times10^{-7}$

$pH = 7 - \log 1.001$

Q28. The hydrogen ion concentration of a 10^{-8} M HCl aqueous solution at 298 K ($K_w = 10^{-14}$) is [CBSE AIPMT 2006]

(a) 1.0×10^{-6} M

(b) 1.0525×10^{-7} M

(c) 9.525×10^{-8} M

(d) 1.0×10^{-8}

$H^+_{soln} = H^+_A + 10^{-7}$

$= 10^{-8} + 10^{-7}$

$= 1.1 \times 10^{-7}$

p^H of Strong Base

Strong Base sol^n = Basic sol^n

Step-1 → p^{OH}

Step-2 → $p^H + p^{OH} = 14$

$$p^H = 14 - p^{OH}$$

$$p^{OH} = -\log[OH^-]_{sol^n}$$

$$\boxed{p^{OH} = -\log[OH^-_B + 10^{-7}]}$$

Calculation Ko easy Krne Ke liye

$[OH^-]_B > 10^{-6}$

$$p^{OH} \approx -\log OH^-_B$$

$$\left(\because OH^-_B + 10^{-7} \approx OH^-_B\right)$$

Q → 10^{-3} M NaOH sol^n, pH = ?

a) 3

b) 11 ✓

c) 11 − log 2

d) 3 + log 2

$OH^-_B = 1\times10^{-3} = 10^{-3}$ M

$pOH = -\log OH^-_B$

$pOH = -\log 10^{-3}$

$pOH = 3$

$pH = 14 - pOH = 14 - 3 = 11$

Q → 10^{-8} M NaOH sol^n, pH = ?

a) 3 ✗

b) 11

c) 7 + log 1.1 ✓

d) 6.998 ✗

$pOH = -\log (OH^-_B + 10^{-7})$

$pOH = -\log (10^{-8} + 10^{-7})$

$pOH = -\log 1.1\times10^{-7}$

$pOH = 7 - \log 1.1$

$pH = 14 - pOH = 14 - (7 - \log 1.1)$

$pH = 7 + \log 1.1$

p^H of mixture of strong acid or strong Base

Acid-1: H_nA, $M_1, V_1 L$ + Acid-2: H_mB, $M_2, V_2 L$ → Resultant soln, $pH = ?$ → $(V_1+V_2) L$

$H^+_T = (n M_1V_1 + m M_2V_2)$

Mole of H_nA = M_1V_1 mole

Mole of H^+ = $n \times M_1V_1$ mole

Mole of H^+ = $m M_2V_2$

$pH = -\log [H^+]_{soln}$

$[H^+]_{soln} = \frac{\text{Mole of } H^+}{\text{total volume}}$

$$[H^+]_{soln} = \frac{nM_1V_1 + mM_2V_2}{V_1+V_2}$$

Q → 10^{-4} M, 2L HCl + 10^{-3}, 2L HCl . pH = ?

a) 3 − log 1.1

b) 3 + log 1.1

c) 4 − log 1.1

✓ d) NONE

$$pH = -\log H^+_{soln}$$

$$[H^+] = \frac{\text{total mole of } H^+}{\text{total vol. of soln}}$$

$$(H^+)_1 = 10^{-4} \times 2 \times 1 \text{ mole}$$

$$(H^+)_2 = 10^{-3} \times 2 \times 1 \text{ mole}$$

$$H^+_{total} = 2\times10^{-4} + 2\times10^{-3}$$

$$= \frac{2\times10^{-4}+2\times10^{-3}}{(2+2)L}$$

$$= \frac{2(10^{-4}+10^{-3})}{4_2} = \frac{10^{-4}+10^{-3}}{2} = \frac{10^{-4}+10\times10^{-4}}{2} = \frac{10^{-4}(1+10)}{2}$$

$$= \frac{11}{2}\times10^{-4} = 5.5\times10^{-4}$$

$$pH = -\log 5.5\times10^{-4}$$

$pH = 4 - \log 5.5$

Q → Equal vol. of (1L) 10^{-4} M NaOH solⁿ mixed (1L) 10^{-3} M another NaOH solⁿ

Calculate p^{OH} of resultant solⁿ

a) $4 - \log 5.5$ ✓

b) $3 - \log 5.5$

c) $3 + \log 5.5$

d) $4 + \log 5.5$

$$p^{OH} = -\log(OH^-)_{soln} = -\log 5.5 \times 10^{-4}$$

$$p^{OH} = 4 - \log 5.5$$

$$[OH^-]_{soln} = \frac{\text{total mole of } OH^-}{\text{total volume}}$$

$$= \frac{10^{-4} \times 1 + 10^{-3} \times 1}{(1+1)} = \frac{10^{-4} + 10^{-3}}{2} = \frac{10^{-4} + 10 \times 10^{-4}}{2}$$

$$= \frac{11 \times 10^{-4}}{2} = 5.5 \times 10^{-4}$$

CSD 1) $-\log x \cdot y \times 10^{-z}$

$p^H = z - \log x \cdot y$

2) $\log 2 = 0.3$

$\log 3 = 0.48$

$\log 5 = 0.7$

$\log 7 = 0.84$

→ $p^H < 7$ → Acidic

→ $p^H > 7$ = Basic

→ $p^H = 7$ → neutral

→ $p^{OH} = -\log [OH^-]_{soln}$

$p^{OH} = -\log (OH^-_B + 10^{-7})$ ↓

Universal formula

$[OH^-]_B > 10^{-6}$ → $p^{OH} \approx -\log OH^-_B$

$(\because OH^-_B \approx OH^-_B + 10^{-7})$

→ p^H of Strong Base

Step-1 → p^{OH}

Step-2 ⇒ $p^H = 14 - p^{OH}$

→ Mole = M × V (litre)

$p^H = -\log H^+$

→ $[H^+] = 10^{-pH}$

→ $[OH^-] = 10^{-pOH}$

Q25. Equal volumes of three acid solutions of pH 3, 4 and 5 are mixed in a vessel. What will be the H^+ ion concentration in the mixture?

1L 1L 1L

$[H^+] = 10^{-pH}$

[CBSE AIPMT 2008]

(a) 1.11×10^{-4} M

(b) 3.7×10^{-4} M

(c) 3.7×10^{-3} M

(d) 1.11×10^{-3} M

$$[H^+] = \frac{\text{total mole of } H^+}{\text{total volume}}$$

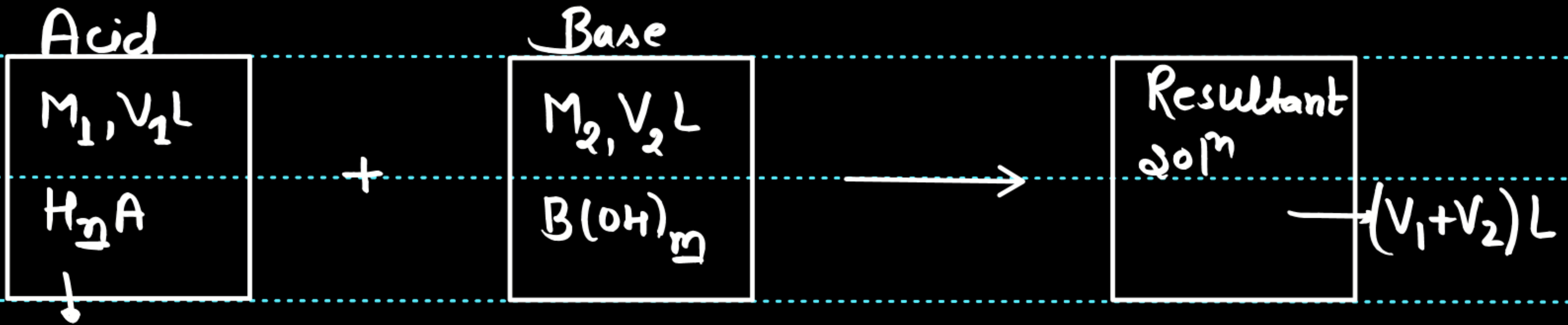
$$= \frac{1\times10^{-3} + 1\times10^{-4} + 1\times10^{-5}}{1+1+1}$$

$$= \frac{100\times10^{-5} + 10\times10^{-5} + 10^{-5}}{3}$$

$$= \frac{111}{3}\times10^{-5} = 37\times10^{-5}$$

$$= 3.7\times10^{-4}$$

p^H of mixture of strong acid & Base



total mole of $H^+ = n M_1 V_1$, total mole of $OH^- = m M_2 V_2$

Acid + Base = Salt + H_2O

$H^+ + OH^- \Rightarrow H_2O$

Acid + Base = Salt + H_2O

$H^+ = n M_1 V_1$ mole

$OH^- = m M_2 V_2$ mole

$H^+ + OH^- \rightarrow H_2O$

H^+	OH^-	H_2O	
10	5	0	t=0
10-5	5-5	5	
5	0	5	

Case-1 → $H^+_{mole} = OH^-_{mole}$ ⇒ neutral solⁿ

pH = 7

Case-2 → $H^+_{mole} > OH^-_{mole}$ ⇒ Acidic solⁿ

pH < 7

$$[H^+]_c = \frac{H^+_{mole} - OH^-_{mole}}{(V_1 + V_2)}$$

Case-3 → $H^+_{mole} < OH^-_{mole}$

= Basic solⁿ → pH > 7

$$[OH^-]_c = \frac{OH^-_{mole} - H^+_{mole}}{(V_1 + V_2)}$$

Q→1 10^{-2} M, 1 L HCl solⁿ + 10^{-2} M, 1 L NaOH solⁿ

Select Correction option

a) pH = 7 ✓

b) pH > 7

c) pH < 7

d) NONE

$H^+_{mole} = 1 \times 10^{-2} \times 1 = 10^{-2}$ mole

$OH^-_{mole} = 1 \times 10^{-2} \times 1 = 10^{-2}$ mole

Neutral solⁿ → pH = 7

Q → 10^{-2} M, 2 L HCl solⁿ + 10^{-2} M, 1 L NaOH solⁿ

Select Correction option

a) $pH = 7$

b) $pH > 7$

c) $pH < 7$ ✓

d) NONE

$H^+_{mole} = 2 \times 10^{-2} \times 1 = 2 \times 10^{-2}$ mole

$OH^-_{mole} = 1 \times 10^{-2} \times 1 = 10^{-2}$ mole

Acidic solⁿ → $pH < 7$

$$[H^+]_{soln} = \frac{2 \times 10^{-2} - 10^{-2}}{3} = \frac{1 \times 10^{-2}}{3}$$

Q → 10^{-2} M, 1 L HCl soln + 10^{-2} M, 2 L NaOH soln

Select Correction option

a) $pH = 7$

b) $pH > 7$ ✓

c) $pH < 7$

d) NONE

$H^+_{mole} = 1 \times 10^{-2} \times 1 = 10^{-2}$ mole

$OH^-_{mole} = 10^{-2} \times 2 \times 1 = 2 \times 10^{-2}$ mole

Basic soln, $pH > 7$

$[OH^-]_{soln} = \frac{2 \times 10^{-2} - 10^{-2}}{1+2} = \frac{1 \times 10^{-2}}{3}$

1·00 pm → class start

SANKALP NEET VEDANTU

MANTHAN NEET 2025

CHEMISTRY

Ionic equilibrium

Lecture-04



Sarvesh Sir

pH of weak acid and weak base

* W·A or W·B = partially ionise

Ex → $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

$10^{-3}M$	0	0	t=0
$10^{-3}M - C$	C	C	at Eq.

Calculate $[H^+]$ $C < 10^{-3}M$

a) $10^{-3}M$

less than $10^{-3}M$

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

CM	0	0	t=0
$C - x$	x	x	at Eq

(x → con; $x = C\alpha$)

Where → x = extent of dissociation

$\alpha = \frac{x}{C}$ = unitless quantity

CM	0	0	t=0
$C(1-\alpha)$	$C\alpha$	$C\alpha$	at Eq

$C - C\alpha$

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

$C \quad\quad 0 \quad\quad 0 \rightarrow t=0$

$C(1-\alpha)$ or $C - C\alpha \quad\quad C\alpha \quad\quad C\alpha$ at Eq.

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]} = \frac{\cancel{C}\alpha \times C\alpha}{\cancel{C}(1-\alpha)} = \frac{C\alpha^2}{(1-\alpha)}$$

$$\boxed{K_a = \frac{C\alpha^2}{1-\alpha}} \quad \boxed{[H^+] = C\alpha}$$

13:3

$$K_a = \frac{C\alpha^2}{(1-\alpha)}$$

Calculation → easy krne ke liye

$\alpha < 5\%$, $\alpha < 0.05$

$1-\alpha \approx 1$ → $1 >>> \alpha$

$$K_a = C\alpha^2$$

→ $$\alpha = \sqrt{\frac{K_a}{C}}$$

$\alpha > 5\%$ or $\alpha > 0.05$

→ $$\alpha = \frac{-K_a + \sqrt{K_a^2 + 4K_aC}}{2C}$$

universal formula

Q → 10^{-2} M CH_3COOH dissociate in water 50%, Calculate pH of solution.

$\frac{50}{100} = \frac{1}{2}$

a) $3 - \log 2$

b) $3 + \log 2$

c) $2 - \log 2$

d) NONE ✓

$CH_3COOH \rightarrow$ W.A. $\rightarrow [H^+] = C\alpha = 10^{-2} \times \frac{1}{2} = 5 \times 10^{-3}$

$pH = -\log H^+_{soln}$

$= -\log 5 \times 10^{-3}$

$pH = 3 - \log 5$

CSD → pH of W.A or W.B.

$[H^+] = C\alpha$ → universal formula

$\alpha = \sqrt{\frac{Ka}{C}}$ → only applicable $\alpha < 5\%$ → $[H^+] = \sqrt{Ka \times C}$ → NEET

$\alpha = \frac{-Ka + \sqrt{Ka^2 + 4KaC}}{2C}$ → universal formula → $[H^+] = \frac{-Ka + \sqrt{Ka^2 + 4KaC}}{2}$

└ universal formula.

Q32. At 25ºC, the dissociation constant of a base, BOH is 1.0×10^{-12}. The concentration of hydroxyl ions in 0.01 M aqueous solution of the base would be **[CBSE AIPMT 2005]**

(a) 2.0×10^{-6} mol L^{-1}

(b) 1.0×10^{-5} mol L^{-1}

(c) 1.0×10^{-6} mol L^{-1}

(d) 1.0×10^{-7} mol L^{-1}

K_b

$[OH^-] = ?$ C

$[OH^-] = \sqrt{K_b \times C}$

$= \sqrt{1 \times 10^{-12} \times 0.01}$

$= \sqrt{10^{-14}} = 10^{-7}$

Q40. Ionisation constant of CH_3COOH is 1.7×10^{-5} and concentration of H^+ ions is 3.4×10^{-4}. Then, find out initial concentration of CH_3COOH molecules. **[CBSE AIPMT 2001]**

(a) 3.4×10^{-4}

(b) 3.4×10^{-3}

(c) 6.8×10^{-4}

(d) 6.8×10^{-3}

Ka

[H+]

C = ?

$$[H^+] = \sqrt{Ka \times C}$$

$$3.4 \times 10^{-4} = \sqrt{1.7 \times 10^{-5} \times C}$$

$$3.4 \times 3.4 \times 10^{-8} = 1.7 \times 10^{-5} \times C$$

$$6.8 \times 10^{-3} = C$$

Q26. A weak acid, HA, has a K_a of 1.00×10^{-5}. If 0.100 mole of this acid is dissolved in one litre of water, the percentage of acid dissociated at equilibrium is closest to **[CBSE AIPMT 2007]**

(a) 99.0%

(b) 1.00%

(c) 99.9%

(d) 0.100%

$\alpha = ?$

$C = \frac{0.1}{1} = 0.1M$

$\alpha = \sqrt{\frac{K_a}{C}}$

$\alpha = \sqrt{\frac{1 \times 10^{-5}}{0.1}} = \sqrt{1 \times 10^{-5} \times 10}$

$\alpha = \sqrt{10^{-4}} = 10^{-2}$

$\% \text{ of } \alpha = 10^{-2} \times 100 = 1\%$

Q46. The concentration of $[H^+]$ and concentration of $[OH^-]$ of a 0.1 M aqueous solution of 2% ionised weak monobasic acid is: (ionic product of water = 1×10^{-14}) **[CBSE AIPMT 1999]**

(a) 0.02×10^{-3} M and 5×10^{-11} M

(b) 1×10^{-3} M and 3×10^{-11} M

(c) 2×10^{-3} M and 5×10^{-12} M

(d) 3×10^{-2} M and 4×10^{-13}

$\alpha = 2\%$ Acid

$[H^+] = C\alpha$

$[H^+] = 0.1 \times \frac{2}{100}$

$[H^+] = 2 \times 10^{-3}$

$K_w = [H^+] \times [OH^-]$

$10^{-14} = 2 \times 10^{-3} \times [OH^-]$

$[OH^-] = \frac{10 \times 10^{-15}}{2 \times 10^{-3}} = 5 \times 10^{-12}$

p^H of weak poly protic acid or Base → NEET me aaj tak Koi Quest^n. nahi aaya hai

polyprotic acid or Base

⇒ those acid or base which gives more than one H^+ or OH^- in aqueous solution

$H_2SO_4 \rightarrow H^+ + HSO_4^-$

$HSO_4^- \rightarrow H^+ + SO_4^{-2}$

S.A. → $H_2SO_4 \rightarrow 2H^+ + SO_4^{-2}$

100%

$H_2S \rightleftharpoons H^+ + HS^- \rightarrow K_1 = 1\times10^{-12}$

$HS^- \rightleftharpoons H^+ + S^{-2} \rightarrow K_2 = 1\times10^{-18}$

⇒ $K_1 > K_2 > K_3$ - - - -

CSD → K_2 = 2nd dissociatn Const

$K_2 < 10^{-8}$

to aap polyprotic acid ko monoprotic acid suppose krke solve kr do,

$H_2S \rightleftharpoons H^+ + HS^- \rightarrow K_1 = 1\times10^{-12}$

$HS^- \rightleftharpoons H^+ + S^{-2} \rightarrow K_2 = 1\times10^{-18}$

→ $[H^+] = \sqrt{K_1 \times C}$

→ $\alpha = \sqrt{\frac{K_1}{C}}$, $[S^{-2}] = K_2$, $[HS^-] = \sqrt{K_1 C}$

Q → 0.01M H_2S ionise as follow

$$H_2S \rightleftharpoons H^+ + HS^- \rightarrow K_1 = 1\times10^{-8}$$

$$HS^- \rightleftharpoons H^+ + S^{-2} \rightarrow K_2 = 1\times10^{-16}$$

Calculate

Q-1 $[H^+] = ?$	Q → Calculate → pH = ?	Q → Calculate Con. of S^{-2}
✓ a) 10^{-5} b) 10^{-3}	✓ a) 5 b) 4.5	✓ a) 10^{-16} b) 10^{-8}
$[H^+] = \sqrt{K_1 \times C} = \sqrt{10^{-8}\times 0.01}$	$pH = -\log[H^+]$	$[S^{-2}] = K_2 = 10^{-16}$
$= \sqrt{10^{-10}} = 10^{-5}$	$= -\log 10^{-5}$ $pH = 5$	

Common Ion effect

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

Q-1 If some amount of product (H^+) Add in Equilb^m. Select the correct option

a) forward	a) degree of diss. of CH_3COOH decrease
b) backward	b) degree of diss. of CH_3COOH increases

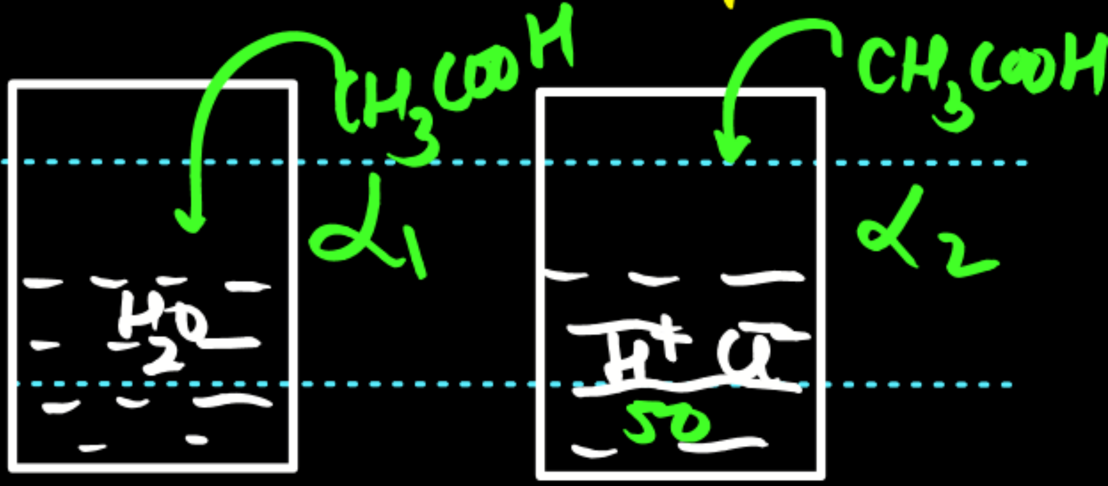
In presence of Common ion, the degree of dissociation of weak electrolyte (weak acid or base) decreases, Because Equilb^m Shifted backward direction.

Q → degree of diss. of CH_3COOH in water and HCl sol^n is α_1, α_2 respectively.

Select Correct option

a) $\alpha_1 = \alpha_2$ b) $\alpha_1 > \alpha_2$ (ticked)

c) $\alpha_1 < \alpha_2$ d) None



$\alpha \downarrow$

←

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

100	0	0
100−3	3	3
		50+3

Q → In which solution / solvent, HCN is more dissociate

↓

α = Jada Kisme hoga

H^+, CN^-

✓ a) Water

✗ b) solⁿ of NaCN

✗ c) solⁿ of HCl

d) equal diss. in all solution

Q → 10^{-7} M HNO_3 solⁿ

pH = ?

a) 7

b) 7 − log 2 ✓

c) 7 + log 2

d) NONE

$pH = -\log H^+_A + 10^{-7}$

$H^+_A = 1 \times 10^{-7} = 10^{-7}$

$pH = -\log 10^{-7} + 10^{-7}$

$= -\log 2 \times 10^{-7}$

$pH = 7 - \log 2$

MANTHAN NEET 2025

CHEMISTRY

Ionic equilibrium

Lecture-05



Sarvesh Sir

Qsd-1 Aqueous solution of acetic acid contains [CBSE AIPMT 1991]

(a) CH_3COO^- and H^+ ✗ → H_3O^+

(b) CH_3COO^-, H_2O^+ and CH_3COOH ✗

(c) CH_3COO^-, H_3O^+ and H^+ ✗

(d) CH_3COOH, CH_3COO^- and H^+ ✓

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

$\neq 0$ $\neq 0$ $\neq 0$

CH_3COOH

CH_3COO^-

H^+

Qsd-2 Calculate pH of mixture of 100 ml, 10^{-2} M HCl and 50 ml, 2×10^{-2} M NaOH solⁿ.

a) pH = 6.72

b) pH = 7 ✓

c) pH = 8.90

d) pH = 3.73

$\frac{?}{2}$

$H^{+}_{mole} = 100 \times 10^{-2} \times 1$ mole $= 1$ millimole

$OH^{-}_{mole} = 50 \times 2 \times 10^{-2} \times 1 = 1$ millimole

neutral solⁿ

pH = 7

Salt hydrolysis

Salt ⇒ Acid + Base = Salt + H_2O

Ex → $HCl + NaOH \longrightarrow NaCl + H_2O$

(NaCl: salt)

Ex → $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

(CH_3COONa: salt)

Ex → $CH_3COOH + NH_4OH \longrightarrow CH_3COONH_4 + H_2O$

(CH_3COONH_4: salt)

Type of salt

Acid
- weak → W·A
- Strong → S·A

Base
- weak → W·B
- Strong → S·A

total 4 type of salt form

1) (S·A + S·B) salt → $HCl + NaOH \rightarrow NaCl$
2) (S·A + W·B) salt $HCl + NH_4OH \rightarrow NH_4Cl$
3) (W·A + S·B) salt $HCN + KOH \rightarrow KCN + H_2O$
4) (W·A + W·B) salt $HCN + NH_4OH \rightarrow NH_4CN + H_2O$

Salt → Cation + Anion

Cation ↓ OH^- → Base

Anion ↓ H^+ → Acid

Ex → $\overset{+}{K}NO_3^-$ → $KOH + HNO_3$

KOH → S.B, HNO_3 → S.A

KNO_3 → (S.A + S.B) Salt

NH_4^+

Ex → $NaCN$ → (W.A + S.B) Salt

$Na^+ + OH^- \rightarrow NaOH \rightarrow$ S.B

$CN^- + H^+ \rightarrow HCN \rightarrow$ W.A

Ex → $(NH_4)_2SO_4 \rightarrow H_2SO_4 + NH_4OH$

$(NH_4)_2SO_4$ → (S.A + W.B) salt

H_2SO_4 → S.A, NH_4OH → W.B

Q → Select (W·A + S·B) salt in given example

✗ a) $NH_4\bar{C}N \rightarrow HCN + NH_4OH$
W·A + W·B

✗ b) $Na_2SO_4 \rightarrow NaOH + H_2SO_4$
S·B   S·A

✓ c) $CH_3COONa \rightarrow NaOH + CH_3COOH$
S·B + W·A

d) $BaCl_2 \rightarrow Ba(OH)_2 + HCl$
S·B   S·A.

CSD → Salt → Acid + Base → Salt + H_2O

4 type of salt

→ (S·A + S·B) salt

→ (S·A + W·B) salt

→ (W·A + S·B) salt

→ (W·A + W·B) salt

2) Salt = Cation + Anion

Cation + OH^- = Base

Anion + H^+ = Acid

→ 3) Nature of salt solution

Jo strong hoga, usi ka nature, solution leta hai

(S·A + S·B) salt → neutral → pH = 7

(S·A + W·B) salt → Acidic → pH < 7

(W·A + S·B) salt → Basic → pH > 7

→ (W·A + W·B) salt
⇓
a) neutral or Acidic or Basic

→ order of pH of salt

soln → (W·A + S·B) salt > (S·A + S·B) salt > (S·A + W·B) salt

CSD → Only W.A or W.B Conjugate ion participate in hydrolysis rxn

→ S.A or S.B Conjugate ion does not participate in hydrolysis rxn

Anion + H^+ = Acid

Cation + OH^- = Base

Q → Select Acidic solⁿ of salt

↓

✗ a) NaCl $\xrightarrow{S \cdot A + W \cdot B}$ NaOH + HCl

b) NaCN → NaOH + HCN → Basic

(S·B above NaOH, W·A above HCN)

✓ c) NH_4Cl → NH_4OH + HCl

W·B + S·A

d) NONE

Q → Select increase order of p^H in given salt sol^n

a) $NaCl < NH_4Cl < NaCN$

b) $NaCN < NaCl < NH_4Cl$

c) $NaCN < NH_4Cl < NaCl$

d) NONE ✓

p^H → Basic > neutral > Acid

$NH_4Cl < NaCl < NaCN$

$NaCl \rightarrow NaOH + HCl$ → neutral → $p^H = 7$
(W.B + S.A)

$NaCN \rightarrow NaOH + HCN$ → Basic → $p^H < 7$
(S.B + W.A.)

$NH_4Cl \rightarrow NH_4OH + HCl$ → Acidic → $p^H > 7$
(W.B, S.A)

Q. The pH of 0.1 M solution of the following salts increases in the order

(A) $NaCl < NH_4Cl < NaCN < HCl$

(B) $HCl < NH_4Cl < NaCl < NaCN$

(C) $NaCN < NH_4Cl < NaCl < HCl$

(D) $HCl < NaCl < NaCN < NH_4Cl$

A A N B

$NaCl \rightarrow NaOH + HCl$

S.B + S.A

$NH_4OH + HCl$

W.B + S.A.

$NaOH + HCN \rightarrow$ Basic

S.B. W.A

Hydrolysis

H — OH ⇒ hydrolysis

Hydrolysis (H–OH)

a) $CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$

b) $CH_3COO^- + H_2O \rightleftharpoons CH_3COO^-(aq)$ or $CH_3COO^-(H_2O)_x$

└ Hydration

Select hydrolysis Rxn

i) a ✓

ii) b

Strong Acid → HNO_3, H_2SO_4, HCl, HBr, HI, $HClO_4$

Weak Acid → HNO_2, H_2SO_3, H_2S, HF, all organic acid

(HCN, HCOOH, AcOH,  etc), H_3PO_4, H_3PO_3, H_3PO_2,

Strong Base → 1st grp & 2nd grp hydroxide (Except → LiOH, $Be(OH)_2$, $Mg(OH)_2$

Weak Base → $Zn(OH)_2$, $Al(OH)_3$, all organic base (CH_3-$\ddot{N}H_2$, ,  etc)

→ NH_3, NH_4OH, NH_2-NH_2

Q → Which ions participate in hydrolysis rxn

✓ a) CH_3COO^- → CH_3COOH → W.A.

✗ b) Cl^- → HCl → S.A.

✗ c) Na^+ → $NaOH$ – S.B.

d) All

Q → Which salt cation participate in hydrolysis rxn

salt
- Anion → ✗
- Cation → ✓

a) NH_4Cl ✓

b) NH_4CN

c) $NaCl$

d) All

$NH_4Cl \rightarrow NH_4OH + HCl$

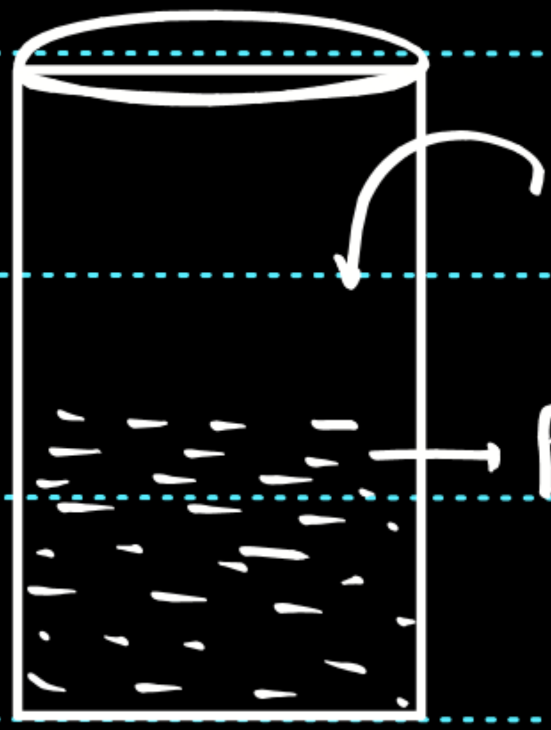
NH_4OH: W.B; HCl: S.A.

$NH_4CN \rightarrow NH_4OH + HCN$

NH_4OH: W.B; HCN: W.A

Salt hydrolysis

pH of salt (weak Acid + strong Base salt)



$CH_3COONa \Rightarrow$ Basic soln → pH > 7

$CH_3COONa \xrightarrow{100\%} CH_3COO^- + Na^+$

Hydrolysis → $CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$

CM	exc	0	0	t=0
$C(1-\alpha)$		$C\alpha$	$C\alpha$	at Eq.
$C(1-h)$		Ch	Ch	at Eq

α → replace by h

h = degree of hydrolysis

$$K_{eq} = \frac{[CH_3COOH][OH^-]}{[CH_3COO^-]}$$

$$K_h = \frac{[CH_3COOH][OH^-]}{[CH_3COO^-]}$$

hydrolysis Constant

$$K_h = \frac{ch \times ch}{c(1-h)}$$

$$\alpha = \sqrt{\frac{K_a}{C}}$$

$$h = \sqrt{\frac{K_h}{C}}$$

$$K_h = \frac{K_w}{K_a}$$

$$pH = 7 + \frac{1}{2} pK_a + \frac{1}{2} \log C_{salt}$$

Salt	h	K_h	p^H & nature
1) (S·A + S·B·) salt	×	×	$p^H = 7$, neutral solⁿ
2) (W·A + S·B) salt	$h = \sqrt{\frac{K_h}{C}} = \sqrt{\frac{K_w}{C \times K_a}}$ $h \propto \frac{1}{\sqrt{C}}$	$K_h = \frac{K_w}{K_a}$	$p^H = 7 + \frac{1}{2} pK_a + \frac{1}{2} \log C_{salt}$ $p^H > 7$ → Basic solⁿ
3) (S·A + W·B) salt	$h = \sqrt{\frac{K_h}{C}}$	$K_h = \frac{K_w}{K_b}$	$p^H = 7 - \frac{1}{2} pK_b - \frac{1}{2} \log C_{salt}$ $p^H < 7$ → Acidic solⁿ

Csp Salt

Salt	h	K_h	pH & nature
4) (W·A + W·B) Salt	$h = \sqrt{K_h}$ Note → value of h does not depend upon Con. of salt	$K_h = \frac{K_w}{K_a \times K_b}$	$pH = 7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b$ Case-1 → $pK_a > pK_b$ $pH > 7$ → Basic solⁿ Case-2 → $pK_a < pK_b$ $pH < 7$ → Acidic solⁿ Case-3 → $pK_a \approx pK_b$ $pH = 7$ → neutral



MANTHAN NEET 2025
CHEMISTRY
Ionic equilibrium
Lecture-06
SANKALP NEET
VEDANTU
10 NOV
→ A.I.T.S = 22 Test → 1499Rs
750 Questn → P+C+B+Z ⇒
Manzil batch
prday → 120Q. → 1999Rs
P+C+B+Z
→ MPS → subjectwise
→ RPS → 60Q → P+C+Z+B
→ DCL lecture
→ Reco: Batch
Vedantu
MASTER TEACHER
Sarvesh Sir

Qsd-1 Select basic solution of given salt

a) ✗ $Na_2SO_4 \rightarrow NaOH + H_2SO_4$

S.B + S.A.

b) ✓ $NaCN \rightarrow NaOH + HCN$

S.B. W.A.

✗ c) $(NH_4)_2SO_4 \rightarrow NH_4OH + H_2SO_4$

W.B S.A.

✗ d) $KNO_3 \rightarrow KOH + HNO_3$

S.B S.A.

Qsd-2 Solution of 10^{-2}M NaCN salt diluted 10 times

↳ Solvent or H_2O

which properties increases

$NaCN \rightarrow NaOH + HCN$

S.B W.A.

a) Con. of salt ✗

b) degree of hydrolysis of salt ↑ $h \propto \frac{1}{\sqrt{C}\downarrow}$ ✓

c) hydrolysis Const of salt → Eq. Const.

d) All

$\frac{?}{2}$

Salt	h	K_h	pH & nature
1) (S·A + S·B·) salt	×	×	$pH = 7$, neutral soln
2) (W·A + S·B) salt	$h = \sqrt{\frac{K_h}{C}} = \sqrt{\frac{K_w}{C \times K_a}}$ $h \propto \frac{1}{\sqrt{C}}$	$K_h = \frac{K_w}{K_a}$	$pH = 7 + \frac{1}{2}pK_a + \frac{1}{2}\log C_{salt}$ $pH > 7 \rightarrow$ Basic soln
3) (S·A + W·B) salt	$h = \sqrt{\frac{K_h}{C}}$	$K_h = \frac{K_w}{K_b}$	$pH = 7 - \frac{1}{2}pK_b - \frac{1}{2}\log C_{salt}$ $pH < 7 \rightarrow$ Acidic soln

Salt	h	K_h	pH & nature
4) (W·A + W·B) Salt	$h = \sqrt{K_h}$ Note → Value of h does not depend upon Con. of salt	$K_h = \frac{K_w}{K_a \times K_b}$	$pH = 7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b$ Case-1 → $pK_a > pK_b$ $pH > 7$ → Basic solⁿ Case-2 → $pK_a < pK_b$ $pH < 7$ → Acidic solⁿ Case-3 → $pK_a \simeq pK_b$ $pH = 7$ → neutral

Q. pK_a of a weak acid (HA) and pK_b of a weak base (BOH) are 3.2 and 3.4 respectively. The pH of their salt (AB) solution is

(A) 7.2 (B) 6.9

(C) 7.0 (D) 1.0

3.2 → pK_a 3.4 → $pK_b = 3.4$

$$\overset{+}{B}\overset{-}{A} \longrightarrow \underset{W.B}{BOH} + \underset{W.A}{HA}$$

$$pH = 7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b$$

$$= 7 + \frac{1}{2}(3.2) - \frac{1}{2}(3.4)$$

$$= 7 + \frac{1}{2}(3.2 - 3.4) = 7 - \frac{1}{2} \times 0.2$$

$$= 7 - 0.1 = 6.9$$

Q→ Calculate the pH of 10^{-2} M CH_3COONa solution.

pK_a of CH_3COOH is 5.24.

$NaOH + CH_3COOH \rightarrow$ Basic

S.B   W.A   pH > 7

a) pH = 7.39

b) pH = 5.72 ✗

c) pH = 6.67 ✗

d) pH = 5.94 ✗

~~e)~~ NONE

$$pH = 7 + \frac{1}{2}pK_a + \frac{1}{2}\log C$$

$$= 7 + \frac{1}{2}(5.24) + \frac{1}{2}\log 10^{-2}$$

$$= 7 + 2.62 - 1$$

$$= 8.62$$

Q→ Calculate degree of hydrolysis of 10^{-2} M NH_4Cl solⁿ

K_b of NH_4OH solⁿ is 10^{-5}

$NH_4OH + HCl$

W·B S·A

a) 2.5×10^{-3}

b) 1×10^{-5}

c) 10^{-3}

d) NONE ✓

$$h = \sqrt{\frac{K_h}{C}}$$

$$K_h = \frac{K_w}{K_b} = \frac{10^{-14}}{10^{-5}} = 10^{-9}$$

$$h = \sqrt{\frac{10^{-9}}{10^{-2}}} = \sqrt{10^{-7}} = \sqrt{10 \times 10^{-8}}$$

$$h = 3.12 \times 10^{-4}$$

Q→ 10^{-2} M HCl mix with equal volume of 10^{-2} M NH_4OH solⁿ

Calculate pH of resultant solution

pK_b of NH_4OH is 5.24.

a) 6.4

b) 7.2 $pH = 7 - 2.62 + 2.30 = 6.68$

c) 5.8

d) NONE

NH_4OH (W.B) + HCl (S.A)

HCl	+	NH_4OH	→	NH_4Cl	+	H_2O	
10^{-2} M		10^{-2} M		0		0	t=0
0		0		$\left(\frac{10^{-2} M}{2}\right) = 5\times10^{-3}$ M		10^{-2}	t sec

$$pH = 7 - \frac{1}{2}pK_b - \frac{1}{2}\log C_{salt}$$

$$= 7 - \frac{1}{2}\times 5.24 - \frac{1}{2}\log 5\times10^{-3} = 7 - 2.62 + \frac{1}{2}(3 - \log 5)$$

Q → equal volume of 10^{-3} M CH_3COOH mix with 10^{-3} M NaOH solⁿ. pKa of CH_3COOH is 5.4, Calculate pH of solⁿ.

a) pH = 7 ✗

b) pH = 5.90 ✗

c) pH = 7.50

d) NONE ✓

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

	CH_3COOH	NaOH	CH_3COONa	H_2O
t=0	10^{-3}	10^{-3}	0	0
	0	0	10^{-3} M	10^{-3} M

Con. of salt $= \frac{10^{-3}}{2}$ M $= 5 \times 10^{-4}$ M

$$pH = 7 + \frac{1}{2}pK_a + \frac{1}{2}\log C$$

$$= 7 + \frac{1}{2}(5.4) + \frac{1}{2}\log 5\times10^{-4}$$

$\log 5\times10^{-4}$

$\log 5 + \log 10^{-4}$

$0.7 - 4$

$$= 7 + 2.7 + \frac{1}{2}(-4 + 0.7) = 7 + 2.7 + \frac{1}{2}(-3.3) = 7 + 2.7 - 1.66$$

Buffer solution

Solution + Add. S.A or S.B = p^H change ho jata hai
↓
Normal solution

Solution + Add S.A or S.B ⟹ p^H approx same (does not altered)
1ml-2ml or 1-2 drop.
↓
→ Buffer solution

→ those solution is called buffer solⁿ, If 1,2 drop or 1-2ml S.A or S.B Added in solution, but p^H of solution does not altered (approx same)

Composition of Buffer solution

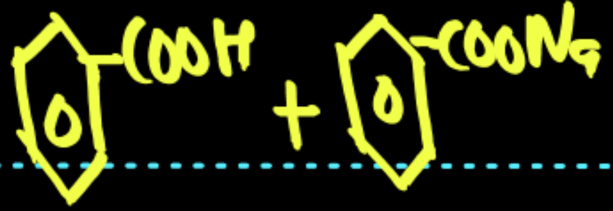
1) (weak Acid + salt of conjugate ion of w.A) mixture → Acidic buffer

2) Weak Base + salt of (conj. ion of w.B) mixture → Basic buffer

3) (weak Acid + weak base) mixture → Acidic or Basic buffer sol^n

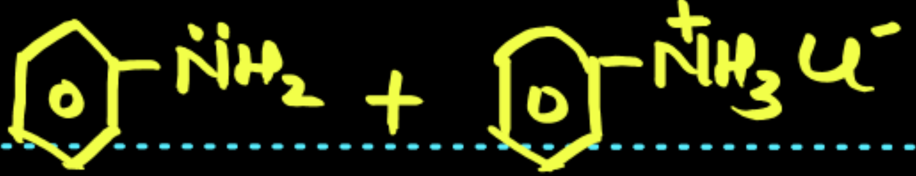
Ex $CH_3COOH + CH_3COONa$

Ex $HCN + NaCN$

Ex 

Ex → $NH_4OH + NH_4Cl$

Ex → $CH_3\ddot{N}H_2 + CH_3\overset{+}{N}H_3Cl^-$

Ex → 

$\ddot{N}H_3 + H_2O \rightarrow NH_4^+$

Ex → $CH_3COOH + NH_4OH$

Q mixture of $HCOOH$ and sodium formate ($HCOONa$) is a

$HCOOH$ → W.A.

$HCOONa$ → salt

a) Buffer solⁿ ✓

b) Acidic buffer solⁿ ✓✓

c) Basic buffer solⁿ

d) ✓✓ A & B both

Q → Select buffer solⁿ

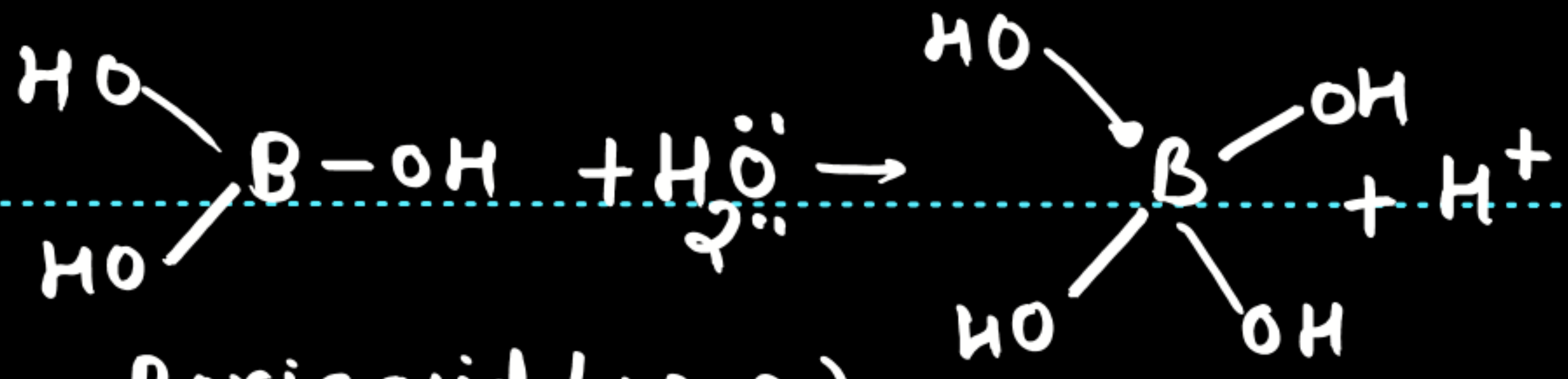
a) $NaCN + HCN$ ✓

b) $H_3PO_4 + NaH_2PO_4$ ✓✓

c) $C_6H_5\ddot{N}H_2 + C_6H_5\overset{+}{N}H_3\bar{Cl}$ ✓✓

d) All ✓✓

Ex → $H_3BO_3 + B(OH)_4^-$



→ Boric acid (W.A.)

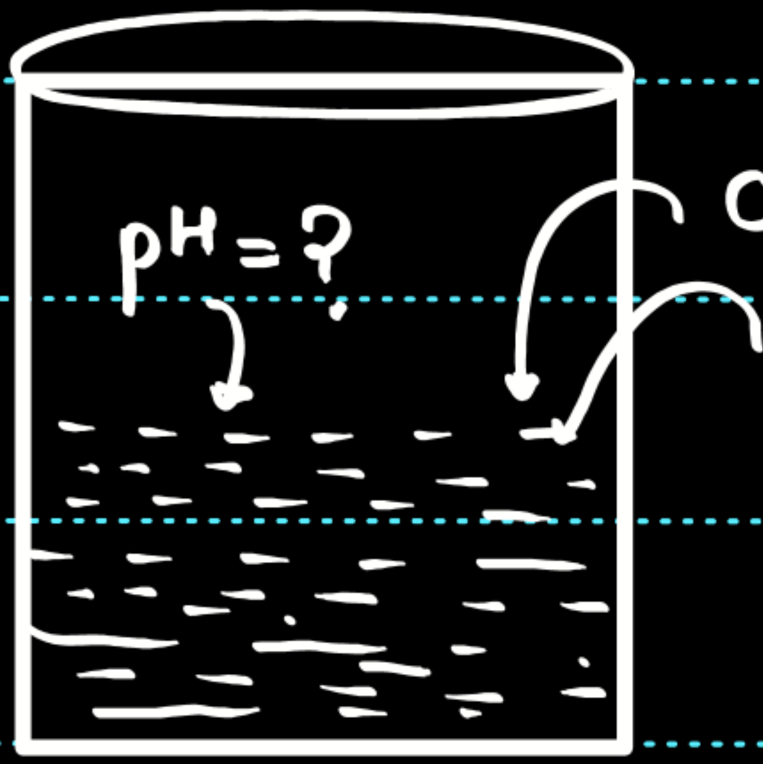
→ electron defficient

or $B(OH)_4^-$

$B(OH)_3 + B(OH)_4^- \rightarrow$ Acidic buffer solⁿ

Borax Salt → $Na_2B_4O_7 \cdot 8H_2O$

pH of Acidic buffer solution



$$CH_3COONa \xrightarrow{100\%} CH_3COO^- + Na^+$$

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

due to Common ion effect, dissociation of Acidic acid → decreases

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

$$[H^+] = \frac{K_a \times [CH_3COOH]}{[CH_3COO^-]}$$

$$pH = -\log H^+$$

$$pH = -\log K_a \times \frac{[CH_3COOH]}{[CH_3COO^-]}$$

$$pH = -\log K_a - \log \frac{[CH_3COOH]}{[CH_3COO^-]}$$

$$pH = pK_a + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$pH = pK_a + \log \frac{[Salt]}{[Acid]}$$

1.00 pm → 3rd class

meri hogi

CSD → Buffer solution = p^H does not altered in Add. of 1ml or 2ml S.A | S.B.

→ W.A + its conj. salt → Acidic buff^r sol^n

→ W.B + its conj. salt → Basic buff^r sol^n

→ W.A + W.B. → Acid | Basic buff^r sol^n

SANKALP NEET VEDANTU

MANTHAN NEET 2025

CHEMISTRY

Ionic equilibrium

Lecture-07

Smart Series

7pm → live → you tube

→ Ionic Equilibrium

→ Statements

→ A&R

→ Matching



Sarvesh Sir

CSD → Buffer solution = pH does not altered in Add. of 1ml or 2ml S.A | S.B.

→ W.A + its conj. salt → Acidic buffer soln

→ W.B + its conj. salt → Basic buffer soln

→ W.A + W.B. → Acid | Basic buffer soln

→ pH of Acidic buffer solution

$$pH = pKa + \log\frac{[Salt]}{[Acid]}$$

$[Salt] \rightarrow \frac{n_{salt}}{\text{Volume}}$, $[Acid] \rightarrow \frac{n_{acid}}{\text{Volume}}$

→ pOH of Basic buffer solution

$$pOH = pK_b + \log\frac{[Salt]}{[Base]}$$

Note → pH or pOH of buffer soln does not change on dilution.

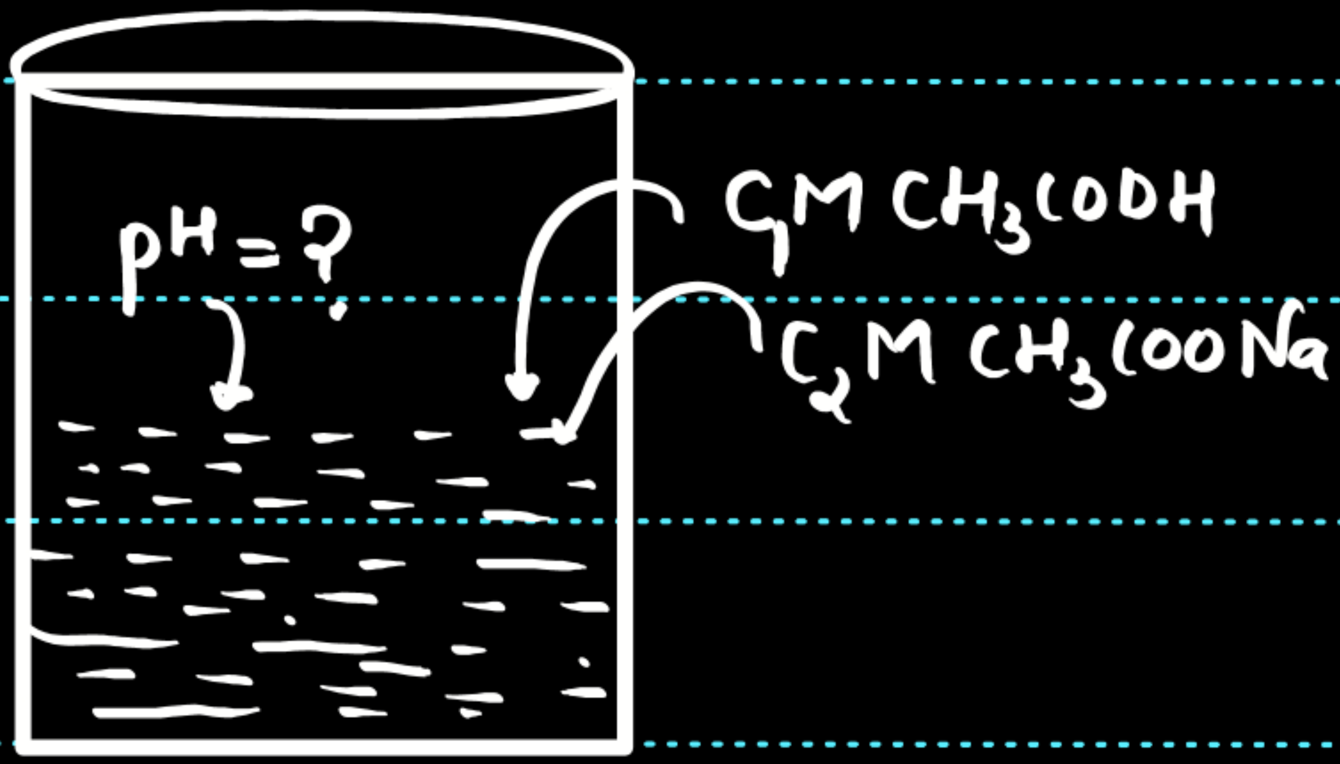
→ Excess W.A + S.B → limit = buffer

→ Excess W.B + S.A → limit = buffer

→ limit W.A + limit S.B = Salt hydrolysis

Sankalp neet vedantu → you tube channel.

pH of Acidic buffer solution



$$CH_3COONa \xrightarrow{100\%} CH_3COO^- + Na^+$$

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

due to Common ion effect, dissociation of Acidic acid → decreases

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

$$[H^+] = \frac{K_a \times [CH_3COOH]}{[CH_3COO^-]}$$

$$pH = -\log H^+$$

$$pH = -\log K_a \times \frac{[CH_3COOH]}{[CH_3COO^-]}$$

$$pH = -\log K_a - \log \frac{[CH_3COOH]}{[CH_3COO^-]}$$

$$pH = pK_a + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$\boxed{pH = pK_a + \log \frac{[Salt]}{[Acid]}}$$

1.00 pm → 3rd class

meri hogi

Q → Calculate pH of mixture of 10^{-3} M CH_3COOH and 10^{-2} M CH_3COONa solution (pKa of CH_3COOH = 5.24)

CH_3COOH ↓ W.A.

CH_3COONa ↓ it salt

a) pH = 5.24

b) pH = 6.24 ✓

c) pH = 4.24

d) NONE

$$pH = pKa + \log \frac{[salt]}{[Acid]}$$

$$pH = 5.24 + \log \frac{10^{-2}}{10^{-3}}$$

$$pH = 5.24 + \log 10$$

$$= 5.24 + 1 = \underline{6.24}$$

13:3

Q → 10^{-2} M CH_3COOH + 10^{-2} M NaOH in equal volume

Calculate pH of solution (pKa of CH_3COOH = 5)

a) 8.25

b) 5.75

c) 6.75

d) NONE

	W.A	S.B		
	CH_3COOH	+ NaOH →	CH_3COONa	+ H_2O
	10^{-2}	10^{-2}	0	0
Resultant soln. →	0	0	10^{-2}	10^{-2}

Con. of salt = $\frac{10^{-2}}{2}$ = 5×10^{-3}

$pH = 7 + \frac{1}{2}pKa + \frac{1}{2}\log C_{salt}$

2.3

$= 7 + \frac{1}{2} \times 5 + \frac{1}{2}(5 \times 10^{-3}) = 7 + 2.5 + \frac{1}{2}(-3 + 0.7)$

$= 7 + 2.50 - 1.15 = 7 + 1.35 = 8.35$

Q → 2×10^{-2} M CH_3COOH + 10^{-2} M NaOH in equal volume

Calculate pH of solution (pKa of CH_3COOH = 5)

a) 8.25

b) 5.75

c) 6.75

~~d)~~ NONE

$$pH = pKa + \log\frac{Salt}{Acid}$$

$$= 5 + \log\frac{10^{-2}}{10^{-2}}$$

pH = 5

	E.R CH_3COOH	+ L.R. NaOH	→ CH_3COONa	+ H_2O	
	2×10^{-2}	10^{-2}	0	0	t=0
	$2\times10^{-2}-10^{-2}$	0			
Resultant soln	10^{-2} (W.A)	0	10^{-2}M (it conj salt)	10^{-2}M	

Q → 10^{-2} M HCN (W.A) + 10^{-2} M KOH (S.B) in equal volume

Calculate pH of solution (pKa of HCN = 6)

a) 8.25

b) 5.75

c) 6.75

d) NONE

Salt hydrolysis

$C_{salt} = \frac{10^{-2}}{2}$

$pH = 7 + \frac{1}{2} pKa + \frac{1}{2} \log C_{salt}$

$= 7 + \frac{1}{2} \times 6 + \frac{1}{2} \log 5 \times 10^{-3}$

$= 7 + 3 + \frac{1}{2}(-3 + \log 5)$

$= 10 + \frac{1}{2}(-3 + 0.7)$

$= 10 + \frac{1}{2} \times 2.3 = 10 - 1.15 = 8.75$

HCN	$+ KOH$	$\rightarrow KCN$	$+ H_2O$
10^{-2}	10^{-2}	0	0
0	0	10^{-2}	10^{-2}

$C_{salt} = \frac{10^{-2}}{2} = 5 \times 10^{-3}$

Q → 2×10^{-2} M HCN + 10^{-2} M KOH in equal volume

Excess W.A   Limit S.B.

Calculate pH of solution (pKa of HCN = 6)

a) 8.25

b) 5.75

c) 6.75

d) NONE

$$pH = pKa + \log\frac{Salt}{Acid}$$

$$pH = 6 + \log\frac{10^{-2}}{10^{-2}}$$

pH = 6

W.A   its conj salt

$$HCN + KOH \rightarrow KCN + H_2O$$

HCN	KOH	KCN	H_2O	
2×10^{-2}	10^{-2}	0	0	t=0
$2\times10^{-2}-10^{-2}$	0	10^{-2}	10^{-2}	
10^{-2}	0	10^{-2}	10^{-2}	

Buffer range

→ $pK_a - 1 \xrightarrow{pH} pK_a + 1$ $= pK_a - \log 10$ to $pK_a + \log 10$

$10 < \frac{\text{Salt}}{\text{Acid}} > \frac{1}{10}$

$\frac{\text{Salt}}{\text{Acid}}$

Solution = $pH = 4.0$

① 1ml HCl Add ⇒ $pH = 3.98$

↓

2ml HCl Add ⇒ $pH = 3.90$

↓

3ml HCl Add ⇒ $pH = 3.30$

↓

4ml ——— ⇒ $pH = 2.98$

Q → A) 10^{-2} M CH_3COOH + 2×10^{-1} M CH_3COONa → $\frac{2\times10^{-1}}{10^{-2}} = 20$ ✗

B) 10^{-2} M CH_3COOH + 2×10^{-2} M CH_3COONa → $\frac{2\times10^{-2}}{10^{-2}} = 2$

Which one is not buffer soln

$\frac{Salt}{Acid}$ → $\frac{1}{10}$ to 10

a) A

b) B

c) both

d) NONE

Q → select buffer solⁿ

× a) 10^{-5} M NH_4OH + 10^{-2} M NH_4Cl → $\frac{10^{-2}}{10^{-5}} = 10^{3} = 1000$

✓ b) 10^{-3} M NH_4OH + 0.5×10^{-3} M NH_4Cl = $\frac{0.5 \times 10^{-3}}{10^{-3}} = 0.5 \rightarrow \frac{5}{10} = \frac{1}{2}$

× c) 10^{-2} M NH_4OH + 10^{-2} M 

× d) NONE

Solubility and solubility product

sparingly soluble salt or Compound = those substance (salt) which is least (very very less) soluble in water

$s <<< 1$ ***

→ $s = 1 \times 10^{-2}$ gram/litre

→ $s = 10^{-27}$ mole/litre

$AB(solid) \rightleftharpoons A^{+}(aq) + B^{-}(aq)$

Solid salt ⇌ aqueous ions

↓ insoluble part ↓ soluble part

$AB(s) \rightleftharpoons A^+(aq) + B^-(aq)$

$K_{eq} = [A^+][B^-]$

$K_{sp} = [A^+][B^-]$

Solubility product

only depend upon temperature

Q → $HgCl_2 (s) \rightleftharpoons Hg^{+2} + 2Cl^-$

$K_{sp} = [Hg^{+2}][Cl^-]^2$

Q → $FeCl_3(s) \rightleftharpoons Fe^{+3} + 3Cl^-$

✗ a) $K_{sp} = [Fe^{+3}][Cl^-]$

✓ b) $K_{sp} = [Fe^{+3}][Cl^-]^3$

c) $K_{sp} = \frac{[Fe^{+3}][Cl^-]^3}{[FeCl_3]}$

d) NONE

13:3

Solubility total amount of solute dissolve in

1 litre = 1000 ml = 1 dm^3 of solution

→ Represent → S

→ unit → $\frac{\text{gram}}{\text{litre}}$ or $\frac{\text{mole}}{\text{litre}}$

$$AB(s) \rightleftharpoons A^+(aq) + B^-(aq)$$

C	0	0	$t=0$
$C-s$	s	s	at Eq.

or

$$AB(s) \rightleftharpoons A^+(aq) + B^-(aq)$$

s → soluble	0	0	$t=0$
0	s	s	at Eq.

$$K_{sp} = [A^+][B^-] = (s)(s) = s^2$$

$$: A_x B_y (s) \rightleftharpoons xA^{+y} + yB^{-x}$$

s	0	0	$t=0$
0	xs	ys	at Eq

$$K_{sp} = [A^{+y}]^x [B^{-x}]^y$$

$$(xs)^x (ys)^y$$

$$K_{sp} = x^x \cdot y^y \cdot (s)^{x+y}$$

$MgCl_2$

$$K_{sp} = (1)^1 (2)^2 s^{(1+2)}$$

$$K_{sp} = 4s^3$$

Q → Calculate Ksp of salt $A_2B_3(s)$. If solubility of salt is $s\ \frac{mole}{Litre}$.

$Ksp = 2^2 \cdot 3^3 \cdot (s)^{2+3}$

$= 4 \cdot 27 \cdot s^5 =$

a) $4 \cdot 27 \cdot s^3$

b) ✓ $4 \cdot 27 \cdot s^5$

c) $2 \times 3 \times s^5$

d) NONE

13:3

Q → Solubility of $Mg(OH)_2$ solid in solution is 10^{-7} $\frac{mole}{litre}$

Calculate solubility product of $Mg(OH)_2$.

a) 10^{-14}

b) 4×10^{-14}

c) 4×10^{-21} ✓

d) NONE

$$K_{sp} = (1)^1 \cdot (2)^2 \cdot (10^{-7})^{1+2}$$

$$= 4\,(10^{-7})^3$$

$$= 4\times10^{-21}$$

Q → $AgCl$, $MgCl_2$ and $AlCl_3$, value of Ksp is equal than arrange solubility order of salt.

(2, 3, 4)

a) $AgCl \approx MgCl_2 \approx AlCl_3$

Solubility ∝ No. of ions

b) $AgCl > MgCl_2 > AlCl_3$

c) $AgCl < MgCl_2 < AlCl_3$ ✓

d) NONE

13:3

Csp → Solubility = total amount dissolved in 1 litre of sol^n

→ sparingly soluble Comp. (salt) → $s <<< 1$, $K_{sp} << 1$

→ $A_xB_y(s) \rightleftharpoons xA^{+y}(aq) + yB^{-x}(aq)$

$K_{sp} = x^x \cdot y^y \cdot (s)^{x+y}$

→ Value of Ksp only depend upon temp.

Case-1 AX, AX_2, AX_3 → Ksp of all salt equal

Solubility order ∝ No. of ions $(x+y)$

Case-2 AX, BX, CX

→ Ksp different

→ No. of ions

Solubility ∝ Ksp

Case-3 No. of Ions, Ksp = different

$Ksp = x^x \cdot y^y \cdot (s)^{x+y}$

Soluhon Krna hoga

Q → $AgCl$ → $K_{sp} = 1 \times 10^{-18}$

$AgBr$ → $K_{sp} = 1 \times 10^{-24}$

AgI → $K_{sp} = 1 \times 10^{-28}$

$K_{sp} = x^x \cdot y^y (s)^{x+y}$

Solubility $\propto K_{sp}$

arrange solubility order

a) $AgCl \approx AgBr \approx AgI$

b) $AgCl > AgBr > AgI$ ✓

c) $AgCl < AgBr < AgI$

d) NONE

Q → AgI → $K_{sp} = 1\times10^{-18}$

MgI_2 → $K_{sp} = 4\times10^{-24}$

arrange solubility order

a) AgI > MgI_2

~~b)~~ AgI < MgI_2

c) AgI ≃ MgI_2

d) NONE

$K_{sp} = x^x \cdot y^y \cdot (s)^{x+y}$

$1\times10^{-18} = (1)^1 (1)^1 (s)^{1+1}$

$s^2 = 10^{-18}$

$s = \sqrt{10^{-18}} = 10^{-9}$

$s = 10^{-9}$

$\cancel{4}\times10^{-24} = (1)^1 \cancel{(2)^2} (s)^{1+2}$

$s^3 = 10^{-24}$, $s = (10^{-24})^{\frac{1}{3}} = 10^{-\cancel{24}^{\,8}\times\frac{1}{\cancel{3}}} = 10^{-8}$

$s = 10^{-8}$

Q. A certain buffer solution contains equal concentration of X^- and HX. The K_b for X^- is 10^{-10}. The pH of the buffer is

(a) 4

(b) 7

(c) 10

(d) 14

$pH = pK_a + \log\frac{Salt}{Acid}$

$pH = pK_a = 4$

$(K_a)_{HX} \times (K_b)_{X^-} = 10^{-14}$

$(K_a)_{HX} = \frac{10^{-14}}{10^{-10}} = 10^{-4}$

$pK_a = -\log K_a = -\log 10^{-4} = 4$

X^- → Salt ©; HX (K_a) → Acid ©

$X^- + H_2O \xrightarrow{K_b} HX + OH^-$

$HX \underset{K_a}{\rightleftharpoons} H^+ + X^-$

$K_a \times K_b = K_w$

SANKALP NEET VEDANTU

MANTHAN NEET 2025

CHEMISTRY

Ionic equilibrium

Lecture-08

→ MD Sir → Wed or thr → Class start kr denge

→ Manjil Batch → start → monday se

→ A.I.T.S → 22 test 6P + 6Fu + 12 NEET



Sarvesh Sir

Q→ which is more soluble

a) $MgS \rightarrow K_{sp} = 1 \times 10^{-17}$ Solubility $\propto$ K_{sp}

b) $ZnS \rightarrow K_{sp} = 10^{-24}$

c) $CaS \rightarrow K_{sp} = 10^{-15}$ //

d) $CuS \rightarrow K_{sp} \rightarrow 10^{-21}$

Q → Solubility of A_2B in water is 2×10^{-3}

Calculate K_{sp}

a) 8×10^{-9}

b) 8×10^{-12}

c) 4×10^{-12}

~~d)~~ NONE

$\frac{?}{2}$

$K_{sp} = (2)^2 (1)^1 (2\times10^{-3})^{2+1}$

$= 4\times(2\times10^{-3})^3$

$4\times2^3\times10^{-9}$

$= 4\times8\times10^{-9}$

$= 32\times10^{-9}$

Common ion effect in solubility of salt

$AgCl(s) \rightleftharpoons Ag^{+}(aq) + Cl^{-}(aq)$ in water ($H^{+} + OH^{-}$)
↳ bahut kam → 10^{-14}

AgCl (s) dissolve in NaCl solⁿ

$AgCl(s) \rightleftharpoons Ag^{+}(aq) + Cl^{-}(aq)$ in NaCl solⁿ

In presence of Common ion (product increase hona), Equilbᵐ shifted backward directⁿ. So solubility of salt decreases

Q→ in which solution solubility of $AgCl(s)$ is maximum

If equal Con. of solution taken.

$AgCl \rightarrow Ag^+ \; Cl^-$

✗ a) $AgNO_3$ solⁿ

✓ b) in water

✗ c) NaCl solⁿ

✗ d) $BaCl_2$ solⁿ

Q→ Calculate solubility of AgCl in water (K_{sp} of AgCl = 1×10^{-18})

$$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$$

	$AgCl(s)$	$Ag^+(aq)$	$Cl^-(aq)$
	s	0	0
	0	s	s

$$K_{sp} = [Ag^+][Cl^-] = (s)^1(s)^1 = s^2$$

$$s = \sqrt{K_{sp}} = \sqrt{10^{-18}} \Rightarrow \boxed{s = 10^{-9}\ \text{mole/litre}}$$

Q→ Calculate solubility of AgCl in 0.1M $AgNO_3$ (K_{sp} of AgCl = 1×10^{-18})

$$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$$

	$AgCl(s)$	$Ag^+(aq)$	$Cl^-(aq)$
t=0	s	0.1M	0
at Eq.	0	(0.1+s)	s

$$K_{sp} = (0.1+s)(s) = 0.1s + s^2$$

$$K_{sp} = 0.1s \quad (\because 0.1s + s^2 \simeq 0.1s)$$

Reason ⇒ because → s^2 is very very small value ($s >>> s^2$)

$K_{sp} = 0.1\,s$

$s = \frac{K_{sp}}{0.1} = \frac{10^{-18}}{0.1} = 10 \times 10^{-18}$

$s = 10^{-17}$

Method-2

$$\text{Solubility} = \frac{K_{sp}}{\text{Con. of Common ion}}$$

$s = \frac{10^{-18}}{0.1} = 10 \times 10^{-18} = 10^{-17}$

Q → Solubility of $AgCl$ in 10^{-2} M $NaCl$ solution

K_{sp} of $AgCl(s) = 10^{-18}$

$[Cl^-] = 1 \times 10^{-2} = 10^{-2}$

a) 10^{-9} mole/litre

b) 10^{-18} mole/litre

c) 10^{-16} mole/litre ✓

d) 10^{-20} mole/litre

$$x = \frac{K_{sp}}{\text{Con. of common ion}}$$

$$= \frac{10^{-18}}{10^{-2}} = 10^{-18} \times 10^{2} = 10^{-16}$$

Q → Calculate solubility of AgOH (s) in $p^H = 10$ solution.

Ksp of AgOH = 10^{-14} (Ag^+, OH^-)

a) 10^{-7} mole/litre

b) 10^{-5} mole/litre

c) 10^{-2} mole/litre

d) NONE ✓

$pH > 7$ → basic solⁿ

$pH + pOH = 14 \Rightarrow 10 + pOH = 14$

$pOH = 4$

$[OH^-] = 10^{-pOH} = 10^{-4}$

$$s = \frac{10^{-14}}{10^{-4}} = 10^{-10} \frac{\text{mole}}{\text{litre}}$$

Calculate Solubility of AgOH(s) in 10^{-4}M OH^- Basic solⁿ?

a) 10^{-15} 10^{2}

b) $(10^{-15})^{2} \Rightarrow 10^{-30}$ $(10^{2})^{2} = 10^{4}$

Value Chhoti value = ?

Ionic product of salt (Quatient Ratio)

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$Q_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$ at any stage of rxn (t=0, 1, 5, 10, 20, 100, 10hr --)

↓

$Q_c \Rightarrow K_{eq} = \frac{[PCl_3][Cl_2]}{[PCl_5]}$ at Eq.

$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$

$Q_c \Rightarrow I.P. = [Ag^+][Cl^-]$ at any stage (t=0, 1, 5, 11, 100, 1hr etc

↓

$Q_c = I.P. \Rightarrow K_{sp} = [Ag^+][Cl^-]$ at Eq.

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

→ $Q_c > K_{eq}$

backward directⁿ = Reactant banega

→ $Q_c < K_{eq}$

→ forward directⁿ = product banega

→ $Q_c = K_{eq}$ → at Equilibrium

$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$

Case-1 I.P > Ksp → backward

→ Reactant banega (ppt form hoga)

Case-2 I.P. < Ksp ⇒ forward

→ Product banega (ppt not form.)

Case-3 I.P = Ksp → at Equilibrium

Q → Equal vol. 10^{-8} M $AgNO_3$ mix with 10^{-12} M NaCl solⁿ. Ksp of AgCl = 10^{-18}

Select Correct option

a) AgCl ppt form

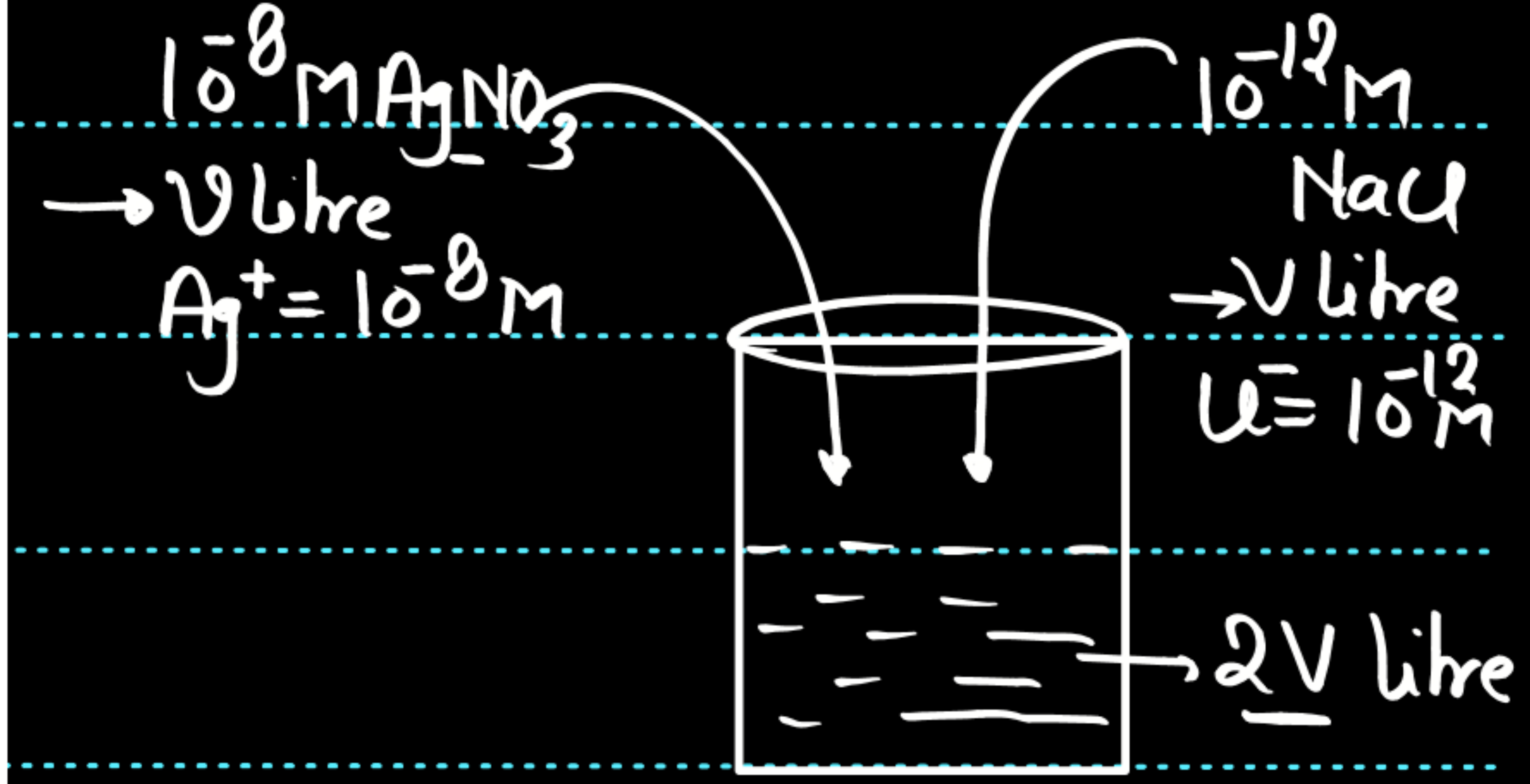
b) AgCl ppt not form ✓

c) Can not say

d) NONE

I.P. < Ksp

→ forward (ppt not form)



$$I.P. = [Ag^+][Cl^-] = \left(\frac{10^{-8}}{2}\right)\left(\frac{10^{-12}}{2}\right)$$

$$= \frac{1}{4} \times 10^{-20} = \frac{10}{4} \times 10^{-21}$$

$$= 2.5 \times 10^{-21}$$

Q → Equal vol. of 10^{-4} M $BaCl_2$ mix with 10^{-8} M H_2SO_4 sol^n

1×10^{-4} 1×10^{-8}

Ksp of $BaSO_4 = 1\times10^{-18}$,

a) $BaSO_4$ ppt form ✓

b) $BaSO_4$ ppt not form

c) both

d) NONE

$$I.P. = [Ba^{+2}][SO_4^{-2}]$$

$$= \left(\frac{10^{-4}}{2}\right)\left(\frac{10^{-8}}{2}\right)$$

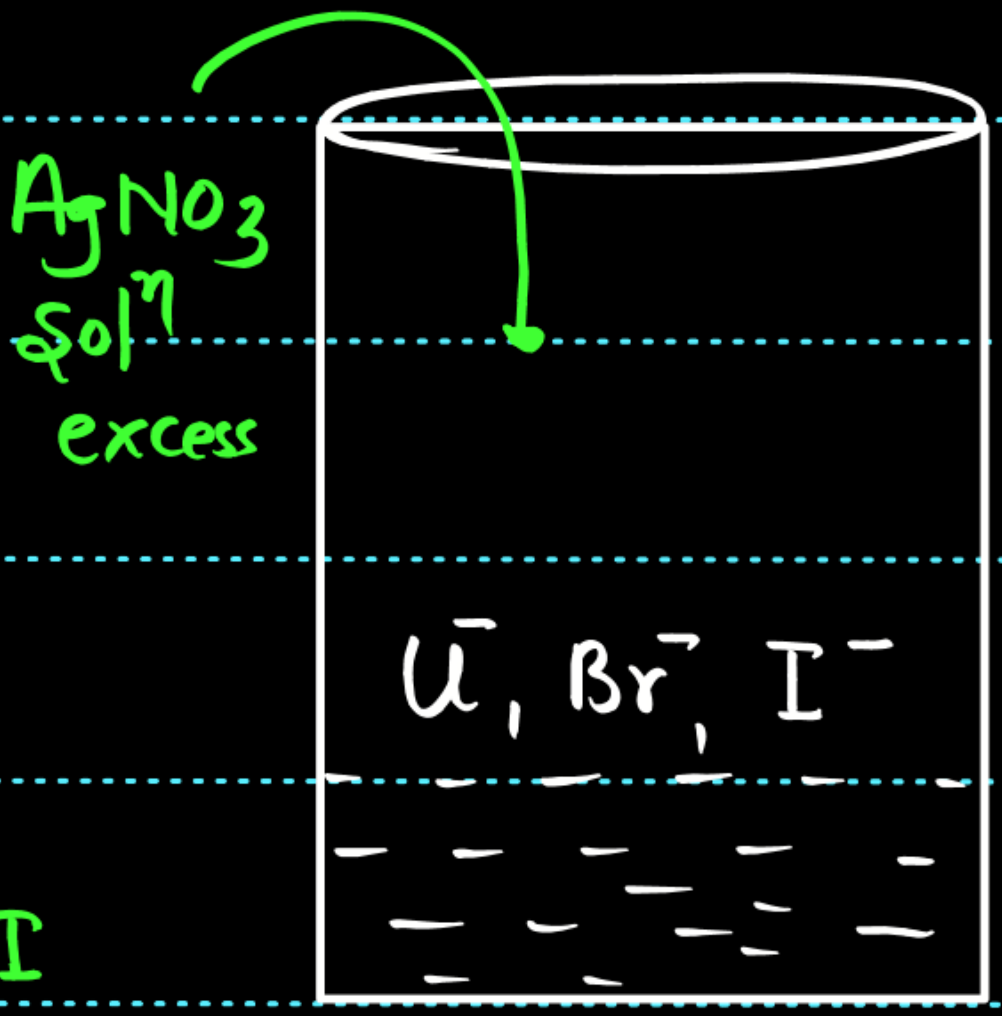
$$= \frac{1}{4}\times10^{-12} = 2.5\times10^{-13}$$

I.P. > Ksp → backward = ppt form

Selective ppt formation

Sarvesh dixit Csd official telegram

all csd → Chapter = handwritten



0.1M NaCl

0.1M NaBr

0.1M NaI

AgCl ppt = 10^{-18} Ksp

AgBr ppt → Ksp = 10^{-22}

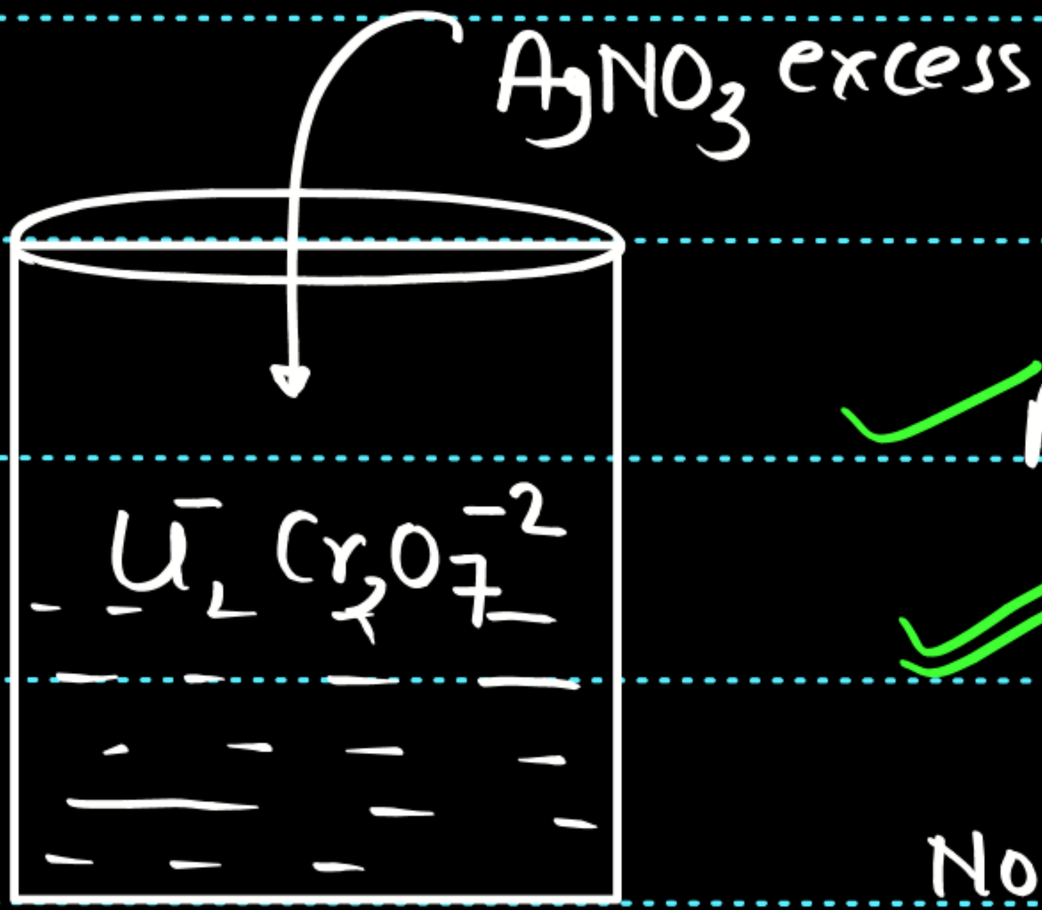
AgI ppt → Ksp ⇒ 10^{-26}

1st → AgI

2nd → AgBr

3rd → AgCl

Q →



0.1 M NaCl

0.1 M $Na_2Cr_2O_7$

↑ (ppt) $\propto \dfrac{1}{\downarrow \text{Con. of } Ag^+}$

✓ $AgCl \rightarrow K_{sp} = 1\times10^{-18} \rightarrow 10^{-18} = [Ag^+]\times 0.1$

✓ $Ag_2Cr_2O_7 = 4\times10^{-18}$

$[Ag^+] = 10^{-17}$

No. of ion = different

$4\times10^{-18} = [Ag^+]^2[Cr_2O_7^{-2}]$

$4\times10^{-18} = [Ag^+]^2 \times 0.1$

$Ag^+ = \sqrt{4\times10^{-17}} = 6.67\times10^{-9}$

CSD → ① in presence of Common ion (same ion), Solubility of salt decreases

2) Solubility of salt in Common ion solution

$$\text{Solubility} = \frac{K_{sp}}{\text{Con. of Common ion}}$$

3) I.P. > Ksp ⇒ backward directⁿ = ppt form

I.P. < Ksp ⇒ forward directⁿ = ppt not form

I.P ≈ Ksp → at Equilibrium

Case-I → No. of ions = same hai

1^{st} ppt form $\propto \frac{1}{K_{sp}}$

Case-2 → No. of ions = different

ppt order $\propto \frac{1}{\text{Con. of } Ag^+}$

Jo upper milya ja raha hai

1·00 pm → aaj·

New-Chapter ⇒ Redox titration

Q . Solubility of AgCl will be minimum in –

(a) 0.001 M AgNO3

(b) Pure water

(c) 0.01 M CaCl2

(d) 0.01 M NaCl

Q 1. A precipitate of CaF_2 ($K_{SP} = 1.7 \times 10^{-10}$) will be obtained when equal volume of the following are mixed -

(a) 10^{-4} M Ca^{2+} and 10^{-4} M F^-

(b) 10^{-2}M Ca^{2+} and 10^{-3} M F^-

(c) 10^{-5} M Ca^{2+} and 10^{-3} M F^-

(d) 10^{-3} M Ca^{2+} and 10^{-5} M F^-

I.P. > Ksp → ppt form

$I.P. = [Ca^{+2}][F^-]^2$

a) $\left(\frac{10^{-4}}{2}\right)\left(\frac{10^{-4}}{2}\right)^2 = \frac{1}{8} \times 10^{-12} \rightarrow < K_{sp}$

b) $\left(\frac{10^{-2}}{2}\right)\left(\frac{10^{-3}}{2}\right)^2 = \frac{1}{8} \times 10^{-8} = 1.25 \times 10^{-9} > K_{sp} \rightarrow$ ppt form

Q 1. Two salts A_2X and MX have the same value of solubility product of 4.0×10^{-12} The ratio of their molarsolubilities i.e $\frac{S(A_2X)}{S(MX)}$ = ______.
(Round off to the Nearest Integer).

3. The solubility of AgCl will be maximum in whith of the following?

(1) 0.01 M KCl
(2) 0.01 M HCl
(3) 0.01 M $AgNO_3$
(4) De ionised water

15. The k_{sp} for bismuth sulphide (Bi_2S_3) is 1.08×10^{-73}. The solubility of Bi_2S_3 in mol L^{-1} at 298 K is

(1)* 1.0×10^{-15}

(2) 2.7×10^{-12}

(3) 3.2×10^{-10}

(4) 4.2×10^{-8}

Q. 20 mL of 0.1 M H_2SO_4 solution is added to 30 mL of 0.2 M NH_4OH solution. The pH of the resultant mixture is [pK_b of $NH_4OH = 4.7$]

(A) 9.3
(B) 5.0
(C) 9.0
(D) 5.2

SANKALP NEET
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MANTHAN NEET 2025

2000

CHEMISTRY

Redox titration

Lecture-01

A·I·T·S → 1499 Rs →

1799Rs

Manjil + A·I·T·S → 2999Rs



Sarvesh Sir

Oxidation number

total Real or Img. charge present in a atom in Combinate state or free state.

Ex → $Na^{+} \Rightarrow +1$

$Cl^{-} \Rightarrow -1$

Ex $O^{-2} = -2$

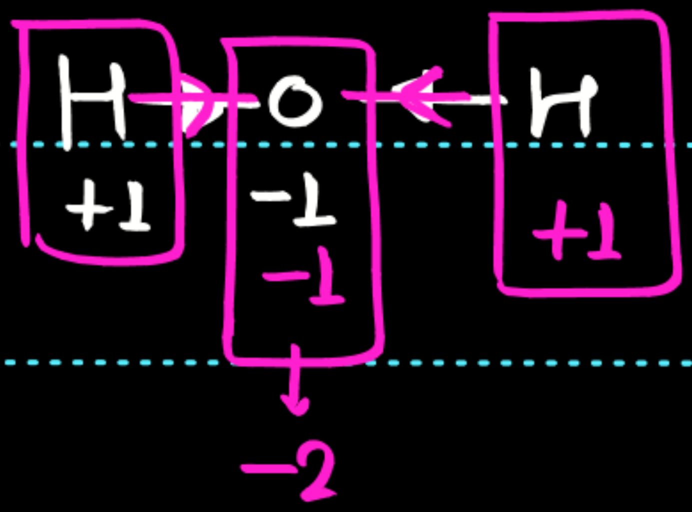
Ex → $Al^{+3} = +3$

Ex → He, Ne, Ar, Kr, Xe → '0'

Ex → Na(s), Mg(s), Zn(s), Al(s), Cu(s) ⇒ '0'.

Ex → $H_2O \Rightarrow H-O-H$

E.N. order → F > O > N ≈ Cl > Br > C > H



Ex → H_2O_2 ⟶ H → O — O ← H

+1   -1   -1   +1

Oxdⁿ. No. of O in H_2O = -2

"   "   " H in H_2O = +1

Oxdⁿ. No. of both 'O' atom = -1

Oxdⁿ. No. of H-atom = +1

Ex → O_2 ⇒ $\overset{0}{O} = \overset{0}{O}$

Oxdⁿ. No. of O-atom in O_2 = zero

P_4, S_8, C_2, O_2, N_2, H_2 = zero

Na(s), Mg(s), Al(s), Zn(s) = zero

Q → How many elements which have oxidation number zero

Al^{+3} ×, O_2 → 0, N_2 → 0, P_4 → 0, S_8 → 0, Na(s) → 0, Mg^{+2} → +2, SO_4^{-2} →, N^{-3} → −3, O^{-2} → −2

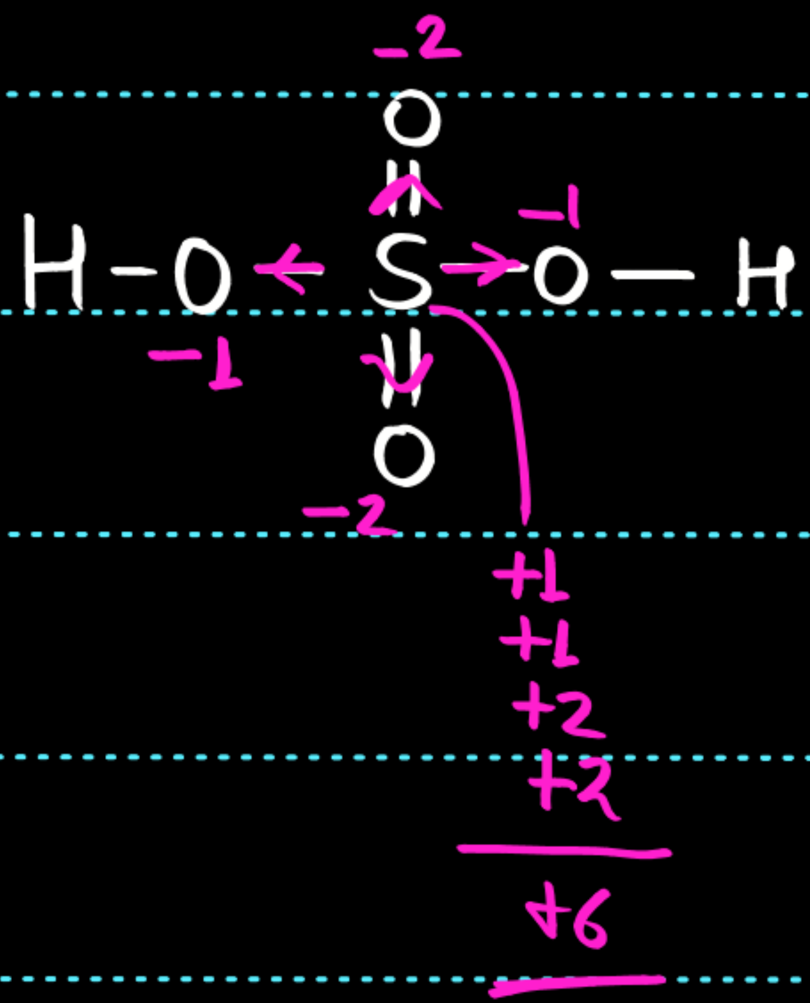
a) 3

b) 4

c) 5 ✓

d) 6

H_2SO_4



Methmatical trick → x-method

Jis atom Ki oxd^n No. nikalni hai ⇒ x

Other atom of molecule/ion oxd^n. No. hum apne pas se put Kr dete hai

grp-1 → +1

grp-2 → +2

grp-13 → +3

grp-14 → +4

grp-15 → -3

grp-16 → -2

grp-17 → -1

sum of oxd^n No. of all atom = Charge present in molecule | ion

H_2SO_4	$KMnO_4$	$K_2Cr_2O_7$ (+6)
$2(+1)+1\times x+4(-2)=0$	$1(+1)+1\times x+4(-2)=0$	$2(+1)+2\times x+7(-2)=0$
$2+x-8=0$	$1+x-8=0$	$2+2x-14=0$
$x=+6$	$x=+7$	$2x=+12$
		$x=+6$

PO_4^{-3}

$1 \times x + 4(-2) = -3$

$x - 8 = -3$

$x = -3 + 8$

$\boxed{x = +5}$

$H_4P_2O_7$

$4(+1) + 2x + 7(-2) = 0$

$4 + 2x - 14 = 0$

$2x = 10$

$\boxed{x = +5}$

NH_3^{0}

$(H_2O)^0$

SO_4^{-2}

$[Cu(NH_3)_6Cl_2]^{-1}$

$x + 6 \times 0 + 2(-1) = -1$

$\boxed{x = +1}$

$CuSO_4 \cdot 4H_2O$

$1 \times x + 1(-2) + 4 \times 0$

$\boxed{x = +2}$

Ex → $K_2Al_2(SO_4)_4 \cdot 6H_2O$

$2(+1) + 2x + 4(-2) + 6(0) = 0$

$2 + 2x - 8 = 0$

$2x = +6$

$x = +3$

Ex → K_2HgI_4

$2(+1) + x + 4(-1) = 0$

$2 + x - 4 = 0, \; x = +2$

Q → match

List-1	List-2	
a) $H_2\underline{S}O_4$ (+6)	p) −3	A → R
b) $H_2\underline{S}$ (−2)	q) −2	B → q
c) $\underline{O}_3$ (0)	r) → +6	C → s
d) $\underline{N}H_4NO_3$	s) → 0	d → P

$NH_4^+ + NO_3^-$

$x+4(+1)=+1$

$x=-3$

NOTE → $\overset{+6}{H_2S_2O_8}$ → Marshall's acid

$H_2\underset{+6}{S}O_5$ → Caro's acid

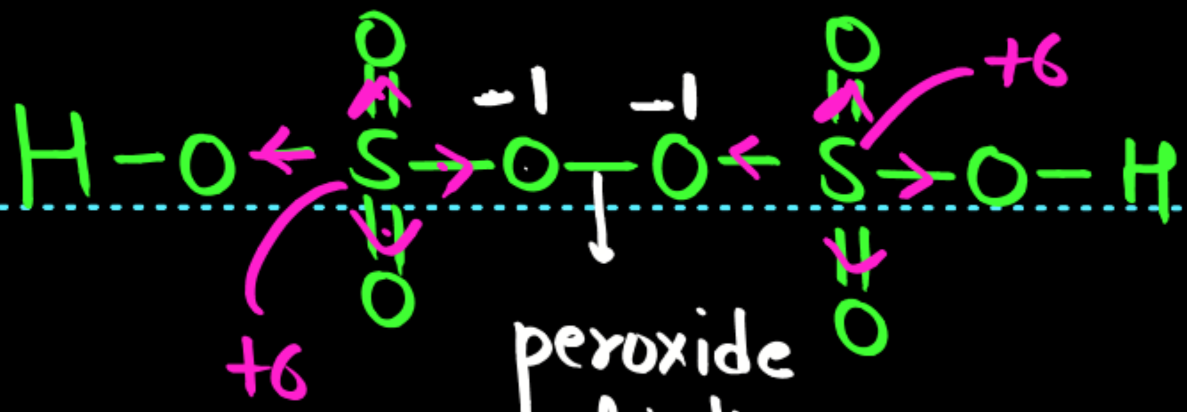
$+2+2x+8(-2)=0$

$2x=+14$

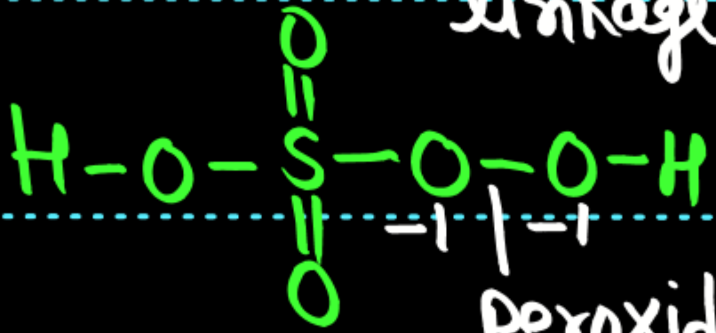
$\boxed{x=+7}$

$+2+x-10=0$

$\boxed{x=+8}$



peroxide linkage

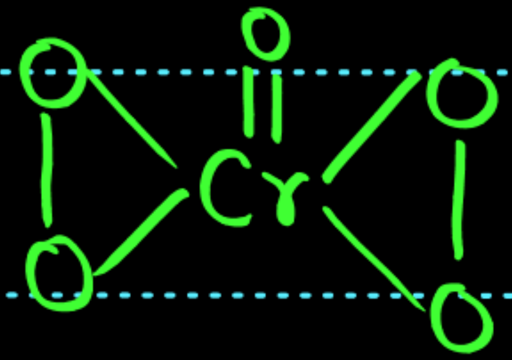


peroxide linkage

$\overset{+6}{CrO_5}$

$x+5(-2)=0$

$x=+10$



Oxidation state

Oxidation Number per atom is called oxidation state → x-method
or
Average of oxidation No. of atom

Avg. oxd^n. State Calculate Krta hai



$$\begin{array}{r} +2 \\ +2 \\ +1 \\ \hline +5 \end{array}$$

$H_2S_2O_3$ → thioSulphuric acid

H_2SO_4 → Sulphuric acid

O → S → thio

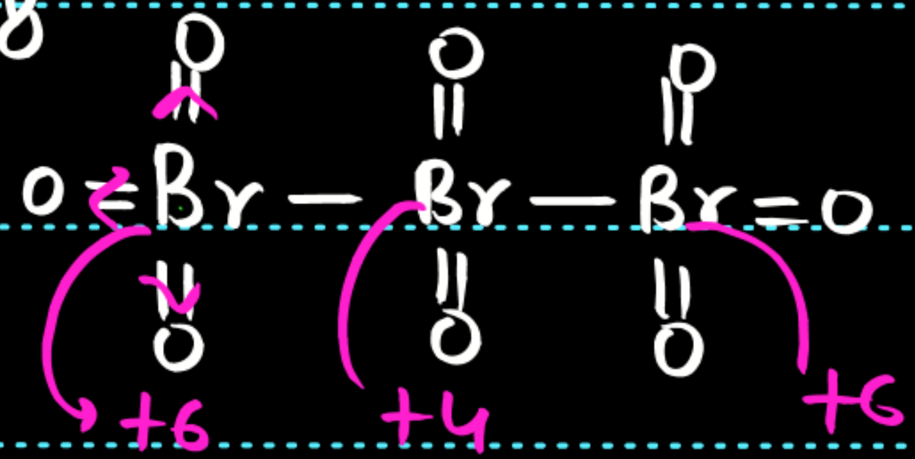
$H_2S_2O_3$

$+2+2x-6=0$

$\boxed{x=+2}$

$= \frac{-1+5}{2} = \frac{+4}{2} = +2$

Br_3O_8



$+\frac{16}{3}$

$3x-16=0$

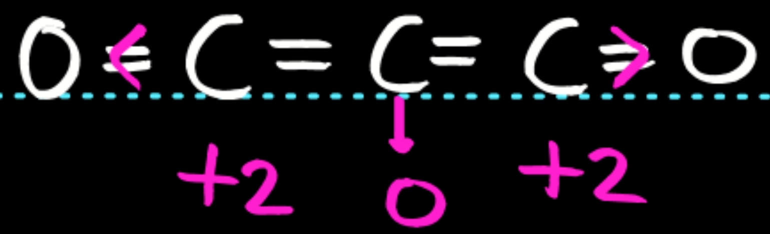
$\boxed{x=+16/3}$ → oxdⁿ state = Avg.

OCl^-

$-2+x=-1$

$x=+1$

Ex→ C_3O_2



$3x-4=0$ → $\boxed{x=+\frac{4}{3}}$ → Avg

Ex→ Bleaching powder

$CaOCl_2 \Rightarrow Ca(OCl)Cl \Rightarrow CaCl_2 + Ca(OCl)_2$

$Ca^{+2} + OCl^- + Cl^-$

OCl^- → +1, Cl^- → −1

$+2-2+2x=0$

$x=0$

CSD → Oxidation No. ⇒ Real or Img. Charge present in a atom.

→ Oxidation No. of atom is a veriable term, depend upon arrangement of atom in a molecule.

→ Same atom se bana molecule → Atom ⇒ Oxd^n No. = zero

→ All metal solid crystal M(s) ⇒ metal = Oxd^n No. = zero

→ Single atom ions = Oxd^n No. = Charge of ion

Na^+, Al^{+3}, Zn^{+2}, Zr^{+4}, O^{-2}, N^{-3}, C^{-4}, P^{-3}

SO_4^{-2}, PO_4^{-3}, BO_3^{-3}

X^-, OH^-, CO_3^{-2}

SO_3^{-2}, NO_2^-, NO_3^-, N^{-3}

O^{-2}, $Cr_2O_7^{-2}$, MnO_4^-

CN^-

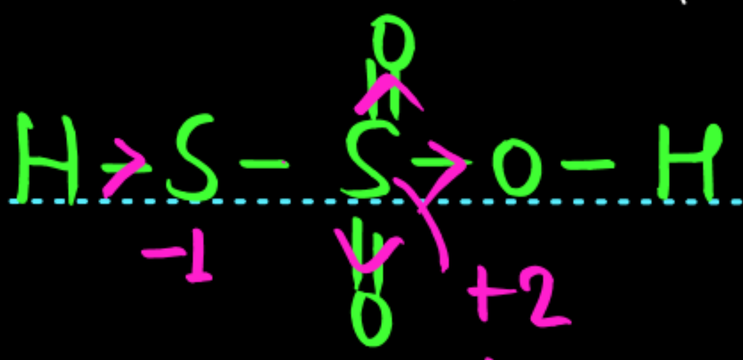
CSD → oxd^n. No. of S→atom maximum = +6

→ oxd^n. No. of Cr-atom maximum = +6

→ oxd^n. No. of Mn-atom maximum = +7

Q→ Oxidation No. of each S atom in

$H_2S_2O_3$



~~a) −1, +5~~

b) +2, +2

c) +6, −2

d) NONE

$+2+2x-6=0$

$x=+2$

$+2$
$+2$
$+1$
$+5$

Oxidation & Reduction

Oxidation	Reduction
→ Addition of O-atom, electronegative element (X^-, N^- etc)	Removal of O-atom, electronegative element
→ Removal of H-atom, electro-positive element	→ Addition of H-atom, electropositive element
→ Removal of e^-	→ Addition of e^-
→ L ⟶ R = oxdn. No. of atom – increases	→ L ⟶ R → oxdn. No. of atom = decrease

Ex → $Mg \longrightarrow Mg^{+2} + 2e^-$

Ex → $S(s) \rightarrow SO_4^{-2}$

$(0) \qquad +6$

Ex → $Hg_2Cl_2 \longrightarrow HgCl_2$

$+1 \qquad +2$

Ex → $C_2O_4^{-2} \longrightarrow CO_2$

$+3 \qquad +4$

(oxallate ion)

Ex → $\overset{0}{O_2} + 4e^- \rightarrow 2\overset{-2}{O^{-2}}$

Ex → $S_8(s) \rightarrow H_2S$

$(0) \qquad (-2)$

Ex → $MnO_4^- \longrightarrow Mn^{+2}$

$(+7) \qquad +2$

Ex → $Cr_2O_7^{-2} \rightarrow Cr^{+3}$

$(+6) \qquad (+3)$

Ex → $I_2(s) \longrightarrow I^-(aq)$

$0 \qquad -1$

Q → Select oxidation process

a) $\overset{0}{Ca} \rightarrow \overset{+2}{Ca^{+2}} + 2e^-$

b) $\overset{0}{O_2} \rightarrow \overset{-2}{O^{-2}}$

c) $\underset{+2}{CO} \rightarrow \underset{+4}{CO_2}$

d) a & c both

Q → Select reduction process

L → R → decrease → Red^n

L → R → increase → oxd^n

✗ a) $\overset{+3}{C_2}O_4^{-2} \longrightarrow \overset{+4}{C}O_2$

✓ b) $\underset{+7}{Mn}O_4^- \longrightarrow \underset{+4}{Mn}O_2$

✗ c) $\underset{0}{Na}(s) \longrightarrow \underset{+1}{Na}^{+1}(aq) + e^-$

✓ d) $\underset{+5}{I}O_3^-(aq) \longrightarrow \underset{-1}{I}^-(aq)$

Q → Select oxidation process

✗ a) $\overset{+6}{Cr_2O_7^{-2}} \longrightarrow \overset{+3}{Cr^{+3}}$

✓ b) $\overset{0}{I_2} \longrightarrow \overset{+5}{IO_3^-}$

✗ c) $\underset{+3}{FeCl_3} \longrightarrow \underset{+2}{FeCl_2}$

✓ d) $\underset{0}{N_2} \longrightarrow \underset{+5}{NO_3^-}$

Equivalent wt

THANK YOU
All the Best!! 👍

MANTHAN NEET 2025

SANKALP NEET VEDANTU

CHEMISTRY

Redox titration

Lecture-02

1:00pm → MD Sir



Sarvesh Sir

Qsd Calculate oxidation No. of Cl-atom

Cl_2O_7

a) −1

$2x + 7(-2) = 0$

b) +5

$2x = +7 \times 2$

$x = +7$

c) +7 ✓

d) +3

Qsd-2 Select Reduction process

└ L → R → oxdⁿ No. = decrease hoti hai

X a) $\overset{0}{Na} \longrightarrow \overset{+1}{Na^{+}} + e^{-}$

✓ b) $\overset{+4}{MnO_2} \longrightarrow \overset{+2}{Mn^{+2}}$

X c) $\overset{0}{Cl_2} \longrightarrow \overset{+5}{ClO_3^{-}}$

X d) $\overset{+1}{Hg_2Cl_2} \longrightarrow \overset{+2}{HgCl_2}$

$\frac{?}{2}$

Redox Reaction

Oxidation and Reduction simultaneous occurs in a chemical Reaction ⇒ Redox reaction

→ Oxidation + Reduction = Redox Reaction

d-Block, p-Block (S, P, N, As, Sn, C, X, last me O-atom), H-atom

Ex → $Fe + ZnSO_4 \rightarrow FeSO_4 + Zn$ → Redox

Oxidation numbers: Fe: 0, Zn (in $ZnSO_4$): +2, Fe (in $FeSO_4$): +2, Zn: 0

Red (Zn: +2 → 0)

Oxdn (Fe: 0 → +2)

Ex → $MnO_4^- + H_2S \rightarrow S_{(s)} + Mn^{+2}$

Oxidation numbers: Mn (in MnO_4^-): +7, S (in H_2S): −2, $S_{(s)}$: 0, Mn^{+2}: +2

Red (Mn: +7 → +2)

Oxdn (S: −2 → 0)

Redox hai

✓ a) Yes b) NO

A.I.T.S. → 1600–1800

at Home

Ex→ $\overset{0}{Cu} + \overset{+5}{HNO_3}$ (dil) $\longrightarrow \overset{+2}{Cu(NO_3)_2} + \overset{+2}{NO} + H_2O$

Redox hai

a) Yes ✓ b) NO

Type of Redox Reaction

a) Combination Redox Reaction ⇒ Add hona ⇒ No. of molecule of Reactant > No. of molecule of product

$A + B \rightarrow AB$, $A + B + C \rightarrow AB + C$

Ex → $Ca + Cl_2 \longrightarrow CaCl_2$

Oxidation states: Ca = 0, Cl_2 = 0 → in $CaCl_2$: Ca = +2, Cl = −1

Ca (0 → +2): Oxd^n; Cl (0 → −1): Red^n

Ex → $2H_2 + O_2 \longrightarrow 2H_2O$

Oxidation states: H_2 = 0, O_2 = 0 → in H_2O: H = +1, O = −2

O (0 → −2): Red^n; H (0 → +1): Oxd^n

2) Decomposition Redox Reaction

(No. of molecule)$_{Reactant}$ < (No. of molecule)$_{prod}$

$AB_2 \longrightarrow A + B_2$

$AB_2C_3 \longrightarrow AB + BC_3$

Ex → $KClO_3 \longrightarrow KCl + Cl_2 + O_2$

Oxidation states: in $KClO_3$: Cl = +5, O = −2 → in KCl: Cl = −1; Cl_2 = 0; O_2 = 0

O (−2 → 0): Oxd^n

Ex → $(NH_4)_2Cr_2O_7 \longrightarrow N_2 + Cr^{+3} + H_2O$

N: -3, Cr: $+6$ → N_2: 0, Cr: $+3$

$+6 \rightarrow +3$: Red^n

$-3 \rightarrow 0$: oxd^n

$(NH_4)_2Cr_2O_7 \longrightarrow NH_4^{+} + Cr_2O_7^{-2} \longrightarrow 2x + 7(-2) = -2 \Rightarrow x = +6$

$x + 4(+1) = +1 \rightarrow x = -3$

3) <u>Displacement Redox Reaction</u> $A + BX \longrightarrow AX + B$

metal displacement Redox $M_1 + M_2X \longrightarrow M_1X + M_2$

Non-metal " " " $X_1 + MX_2 \longrightarrow X_2 + MX_1$

Ex → $\overset{0}{Zn} + \overset{+2}{Cu}SO_4 \rightarrow \overset{+2}{Zn}SO_4 + \overset{0}{Cu}$

Ex → $\overset{0}{F_2} + H\overset{-1}{Cl} \rightarrow H\overset{-1}{F} + \overset{0}{Cl_2}$

Oxdn (Cl: $-1 \rightarrow 0$)

Redn (F: $0 \rightarrow -1$)

4) Disproportionation Redox Reaction

- Same atom → Reduction
- Usi atom → oxidation

$\overset{0}{Cl_2} + OH^- \rightarrow \overset{-1}{Cl^-} + \overset{+5}{Cl}O_3^-$

Oxdn ($0 \rightarrow +5$)

Redn ($0 \rightarrow -1$)

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

Oxidation states: H in H_2O_2: $+1$, O in H_2O_2: -1; H in H_2O: $+1$, O in H_2O: -2; O in O_2: 0

O: $-1 \rightarrow -2$: Red^n

O: $-1 \rightarrow 0$: oxd^n

Ex → $P_4 + NaOH \longrightarrow PH_3 + NaH_2PO_2$

Oxidation states: P in P_4: 0; P in PH_3: -3; P in NaH_2PO_2: $+1$

P: $0 \rightarrow +1$: oxd^n

P: $0 \rightarrow -3$: Red^n

Q → match the following A →

List-I (Redox)	List (Type of redox rxn)
a) $\overset{+1}{Hg_2Cl_2} \rightarrow \overset{+2}{HgCl_2} + \overset{0}{Hg}$ A → P, A → S	p) Disproportionation
b) $\overset{0}{I_2} + OH^- \rightarrow \overset{-1}{I^-} + \overset{+5}{IO_3^-}$ → P	q) Displacement
c) $2\overset{0}{Na} + \overset{0}{H_2} \rightarrow 2\overset{+1}{Na}\overset{-1}{H}$ C → r	r) Combination
d) $\overset{0}{Cu} + 2\overset{+1}{Ag}Cl \rightarrow 2\overset{0}{Ag} + \overset{+2}{Cu}Cl_2$	s) decomposition

d → q

Oxidising agent & Reducting agent

$$\overset{+7}{MnO_4^-} + \overset{-2}{H_2S} \longrightarrow \overset{0}{S}(s) + \overset{+2}{Mn^{+2}}$$

oxdn ($H_2S \rightarrow S$)

Redn ($MnO_4^- \rightarrow Mn^{+2}$)

Oxidising agent = Self me Reduction Krta hai
(oxidant)

Reducing agent = Self me oxidation Krta hai
(Reductant)

Q – $\overset{+6}{K_2Cr_2O_7} + \overset{-1}{HCl} \rightarrow \overset{+3}{Cr^{+3}} + \overset{0}{Cl_2} + K^+ + H_2O$

Redⁿ ($K_2Cr_2O_7 \rightarrow Cr^{+3}$), Oxdⁿ ($HCl \rightarrow Cl_2$)

Select Correct option

a) $K_2Cr_2O_7 \rightarrow$ O.A.

b) $K_2Cr_2O_7 \rightarrow$ R.A.

c) $HCl \rightarrow$ O.A.

d) $HCl \rightarrow$ R.A.

a) $K_2Cr_2O_7$ – O.A. ✓

b) $Cr^{+3} \rightarrow$ O.A. ✗

c) $HCl \rightarrow$ O.A. ✗

d) $Cl_2 \rightarrow$ O.A. ✓

Q → $\overset{0}{Cu} + \overset{+5}{HNO_3} \longrightarrow \overset{+2}{Cu(NO_3)_2} + \overset{+4}{NO_2} + H_2O$ → NCERT

(Cu → R.A, HNO_3 → O.A.)

Con.

Select oxidising agent in above redox reaction

↓ Self Reduction

a) Cu

b) HNO_3 ✓

c) NO_2

d) All

CSD Redox Reactⁿ = oxidation + Reduction

→ Combination Redox rxn = Add → Molecule/atom + Redox

→ Decomposition Redox rxn = decompose = molecule/Ion + Redox

→ Displacement Redox rxn = Metal or nonmetal displace (position exchange) + Redox

→ Disproportionation Redox rxn = Same atom Ka oxidⁿ and Reductⁿ.

Oxidising agent (oxidant) = Jo self me Reduction Karenga

Reducing agent (Reductant) = Jo self me oxidation Karenga

Equivalent wt of atom

Eq. wt of atom | molecule = variable term

Suppose → Equivalent wt H-atom = 1, E wt of O-atom = 8 gram = $\frac{1}{2}$ mole

Mass of atom which is combine with | Replace by

→ 1 mole of H-atom or 1 gram of H-atom or

→ $\frac{1}{2}$ mole of O-atom or 8 gram of O-atom or

1 mole Cl-atom or 35.5 gram of Cl-atom or

1 mole Ag-atom or 108 gram Ag-atom.

Ex → HCl, E·wt of Cl-atom in HCl molecule

H_1Cl_1 = 1 mole H-atom + 1 mole Cl-atom

E·wt of Cl-atom = 1 mole = 35.5 gram

Ex → H_2O, E·wt of O-atom in H_2O

2 mole H = 1 mole O-atom

1 mole H = $\frac{1}{2}$ mole O-atom

E·wt of O-atom = $\frac{1}{2}$ mole = $\frac{1}{2} \times 16$ = 8 gram

Q → E·wt of O-atom in H_2O_2

a) 8 gram

b) 16 gram

c) 32 gram

d) NONE

E·wt of O-atom = 1 mole = 16 gram

Ex → CaO, E.wt of Ca

E.wt of Ca = $\frac{1}{2}$ mole = $\frac{1}{2} \times 40$ = 20 gram

Ex → Al_2O_3, E.wt of Al (A.wt of Al = 27)

a) 27g

~~b)~~ 9 gram

c) 18g

d) NONE

$3 \longrightarrow 2$

$1 \longrightarrow 2/3$

$\frac{1}{2} \longrightarrow \frac{2}{3} \times \frac{1}{2} = \frac{1}{3}$ mole $= \frac{1}{3} \times 27 = 9g$

13:3

Q → 4 gram metal Combine with 2gram oxiygen atom and metal oxide, Calculate E.wt of metal

a) 4g

b) 8g

~~c) 16g~~

d) 32g

8gram O-atom = $\frac{1}{2}$mole O-atom

2gram O-atom = 4g

8gram O-atom = 4×4 = 16g

Q → metal react with 2gram O-atom and form 6gram metal oxide, Calculate E.wt of metal

a> 4g

~~b> 16g~~

c> 8g

d> 32g

Conversahon of Mass

Metal + oxygen = metal oxide

4gram 2gram = 6gram

2gram = 4g metal

8gram = 4×4 = 16g

E.wt of molecule

THANK YOU
All the Best!! 👍

MANTHAN NEET 2025

CHEMISTRY

Redox titration

Lecture-03

Qsd → ?

→ N.Y.T.S →

→ A.I.T.S → part test → 11th → 2 + 2 full

Jan last ← 12th → 2 + 2 full

1 Feb → full → 12'



Sarvesh Sir

Which of the following arrangements represent increasing oxidation number of the central atom?

(i) CrO_2^- , ClO_3^- , CrO_4^{2-} , MnO_4^-

(ii) ClO_3^- , CrO_4^{2-} , MnO_4^- , CrO_2^-

(iii) CrO_2^- , ClO_3^- , MnO_4^- , CrO_4^{2-}

(iv) CrO_4^{2-} , MnO_4^- , CrO_2^- , ClO_3^-

Q7 In which of the following compounds, an element exhibits two different oxidation states.

(i) NH_2OH

(ii) NH_4NO_3 → $\overset{-3}{N}H_4^+ + \overset{+5}{N}O_3^-$

(iii) N_2H_4 → NH_2-NH_2

(iv) N_3H →

Which of the following is **not** an example of redox reaction?

(i) $CuO + H_2 \longrightarrow Cu + H_2O$

(ii) $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

(iii) $2K + F_2 \longrightarrow 2KF$

(iv) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$

Equivalent weight of molecule

M.wt = sum of atomic wt of all atom present in a molecule

E.wt ⇒ Sum of Eq.wt of atom present in a molecule

Ex → H_2O → M.wt = $2\times1 + 1\times16 = 2+16 = 18$

→ E.wt = Eq. of H-atom + Eq. of O-atom

E.wt = $1 + 8 = 9 = \frac{18}{2}$

$(E.wt)_{H_2O} = \frac{(M.wt)_{H_2O}}{2}$

$$E \cdot wt = \frac{M \cdot wt}{n\text{-factor}}$$

→ n-factor = always +ve, fractional, whole no.

→ $n > 1$, $n = 1$, $n < 1$

→ $n \neq 0$, $n \neq$ negative

n-factor → Acid

→ Base

→ Salt

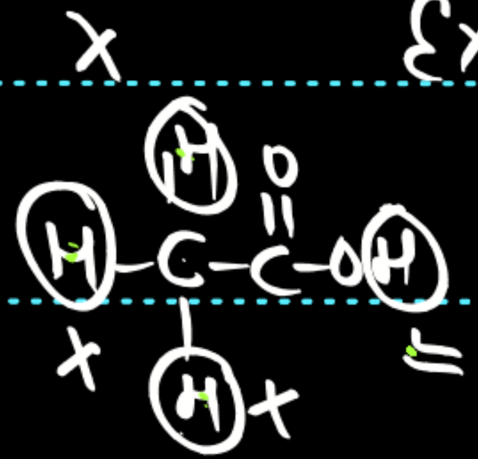
n-factor of Acid (Basicity)

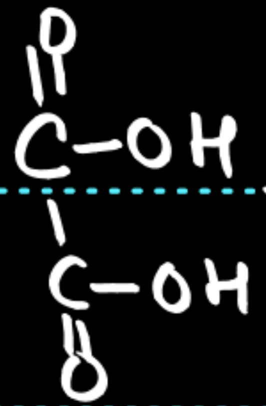
total No. of OH^- required to neutralisation of 1 mole of Acid.

$$H^+ + OH^- \rightarrow H_2O$$

or total No. of Acidic H^+ present in 1 mole of Acid

$(S, O, X)-H \rightarrow$ Acidic Hydrogen



Ex → $HCl \rightarrow n = 1$,  $\rightarrow n = 2$, $H_2S \rightarrow n = 2$

$H_2SO_4 \rightarrow n = 2$

$H_2O_2 \rightarrow n = 2$

$CH_3COOH \rightarrow n = 1$

Q → Calculate η-factor of given Acid

a) H_3PO_4 → HO–P(=O)(OH)–OH → η = 3

b) H_3PO_3 → H–P(=O)(OH)–OH → η = 2

c) H_3PO_2 → H–P(=O)(OH)–H → η = 1

d) $H_2S_2O_3$ → H–S–S(=O)(=O)–OH → η = 2

Q-1 Calculate η-factor H_2SO_4

$$E.wt = \frac{M.wt}{\eta} \quad (M.wt \rightarrow Const, \; \eta \rightarrow Variable, \; E.wt \rightarrow Variable)$$

$\eta = 2 \rightarrow E.wt = \frac{M.wt}{2} \rightarrow E.wt < M.wt$

Q-2 Calculate η-factor of H_2SO_4 in given rxn

$$H_2SO_4 + NaOH \longrightarrow NaHSO_4 + H_2O$$

$\eta = 1$ $\quad E.wt = \frac{M.wt}{1} \rightarrow E.wt = M.wt$

Q-3 Calculate η-factor of H_2SO_4 in given rxn

$$2H_2SO_4 + NaOH \longrightarrow NaH_3(SO_4)_2 + H_2O \rightarrow E.wt = \frac{M.wt}{\frac{1}{2}} = 2 \times M.wt$$

$\eta = \frac{1}{2}$ $\quad$ 2 mole $H_2SO_4 = 1$

1 mole H_2SO_4

$E.wt > M.wt$

η-factor of Base (Acidity)

total No. of H^+ required to neutralisation of 1 mole of Base

$$\underline{H^+} + \underline{O\bar{H}} \rightarrow H_2O$$

or total No. of Basic-$O\bar{H}$ (Ionic -OH) present in 1 mole Base

Metal-(OH), Cation-(OH)

Basic

Ex → NaOH → $\eta = 1$, $Al(OH)_3 \rightarrow \eta = 3$, CH_3-(OH) → ⊗

$Ca(OH)_2 \rightarrow \eta = 2$, $Zr(OH)_4 \rightarrow \eta = 4$, $\overset{+}{N}H_4\overset{-}{O}H$ or $NH_3 \rightarrow \eta = 1$

Q → η-factor of $Ba(OH)_2$

a) 1

$\eta = 2$

b) 2 ✓

c) $\frac{1}{2}$

d) NONE

Q → 1 → η-factor of $Al(OH)_3$

$\eta = 3$

Q → 2) η-factor of $Al(OH)_3$

$$Al(OH)_3 + 2HCl \rightarrow Al(OH)Cl_2 + 2H_2O$$

(2)

a) 1 b) 2 ✓ c) 3 d) NONE

$\eta = 2$

η-factor of Salt = total +ve charge or −ve charge present in 1 mole

Salt

Ex → Salt → neutral → +ve = −ve

X^-, SO_4^{-2}, PO_4^{-3}, CO_3^{-2}

OH^-, NO_3^-, SO_3^{-2}, NO_2^-

$NaCl \rightarrow Na^+ + Cl^-$

↳ $\eta = 1$

$Na_2SO_4 \Rightarrow 2Na^+ + SO_4^{-2} \rightarrow \eta = 2$

$Al_2(SO_4)_3 \Rightarrow \eta = 6$

Ex → $K_2(SO_4) \cdot Al_2(SO_4)_3 \longrightarrow \eta = 8$

$+2 \quad +6 = +8$

$MnO_4 \longrightarrow Mn^{+8} + 4O^{-2}$

Ex → $\overset{+2}{Fe}SO_4 \longrightarrow \eta = 2$

$\overset{+3}{Fe_2}(SO_4)_3 \longrightarrow \eta = 6$

$KMnO_4 \longrightarrow \eta = 1$

$K^+ + MnO_4^-$

Anion

Q → η-factor of $Ca_3(PO_4)_2$

a) 3

b) 2

c) 6 ✓

d) 4

Ca^{+2}

$+2 \times 3 = 6$

η-factor of Oxidation or Reduction half Reaction

$$\overset{+p}{A_xB_y} \longrightarrow \overset{+q}{A_{x_1}B_{y_1}}$$

$p < q \rightarrow$ oxidation

$p > q \rightarrow$ Reduction

η-factor of $A_xB_y = x|p-q|$

η-factor of $A_{x_1}B_{y_1} = x_1|q-p|$

*** $\overset{+6}{Cr_2O_7^{-2}} \longrightarrow \overset{+3}{Cr^{+3}}$ (Acidic or Basic)

└→ n factor $Cr_2O_7^{-2} = 2|6-3| = 6$

*** $\overset{+7}{KMnO_4} \longrightarrow \overset{+2}{Mn^{+2}}$ (Acidic Med)

└→ n-factor of $KMnO_4 = 1|7-2| = 5$

$\overset{+7}{KMnO_4} \longrightarrow \overset{+4}{MnO_2}$ (neutral med.)

n-factor of $KMnO_4 = 1|7-4| = 3$

$\overset{+7}{KMnO_4} \longrightarrow \overset{+6}{K_2MnO_4}$ (Basic med.)

n-factor of $KMnO_4 = 1|7-6| = 1$

$\overset{+7}{KMnO_4} \longrightarrow \overset{+4}{MnO_2}$ (Strong Basic Med)

n-factor of $KMnO_4$

$= 1|7-4| = 3$

Ex → $\overset{+3}{H_2C_2O_4} \longrightarrow \overset{+4}{CO_2}$

$\hookrightarrow 2|3-4| = 2$

Ex → $\overset{0}{I_2} \longrightarrow \overset{+5}{IO_3^-}$

$\hookrightarrow 2|0-5| = 10$

Ex → $\overset{-2}{H_2S_1} \longrightarrow \overset{0}{S}$

$\hookrightarrow 1|-2-0| = 2$

Ex → $\overset{+2}{Na_2S_2O_3} \longrightarrow \overset{+2.5}{Na_2S_4O_6}$

$\hookrightarrow 2|2-2.5| = 1$

CSD1) Eq wt of Molecule = Sum of Eq. wt of different atom present in molecule

$$\text{Eq. wt} = \frac{\text{M.wt}}{\eta\text{-factor}}$$

→ η = whole no., fractional

→ $\eta = 1$, $\eta > 1$, $\eta < 1$

→ $\eta \neq 0$, $\eta \neq$ negative

→ η-factor of Acid = total Acidic H^+ in 1 mole of Acid (Basicity)

η-factor Base (Acidity) = total Ionic OH^- present in 1 mole of Base

η-factor of Salt = total +ve or -ve present in 1 mole of salt

MANTHAN NEET 2025

SANKALP NEET VEDANTU

CHEMISTRY

Redox titration

Lecture–04



Sarvesh Sir

Qsd-1 Calculate E.wt of H_3PO_4 (M.wt = 98)

$$H_3PO_4 + NaOH \longrightarrow NaH_2PO_4 + H_2O$$

$\eta = 1$

a) 98 ✓

b) 49

$$E.wt = \frac{M.wt}{\eta} = \frac{98}{1} = 98$$

c) $\frac{98}{3}$

d) NONE

Qsd-2

$\overset{0}{N_2} \longrightarrow \overset{+5}{NO_3^-}$, E.wt of N_2

a) $\frac{M}{2}$

η-factor $= 2|0-5| = 10$

E.wt $= \frac{M.wt}{10}$

$\frac{?}{2}$

b) $\frac{m}{10}$ ✓

c) $\frac{m}{5}$

d) NONE

14. The reaction, $3ClO^-(aq) \rightarrow ClO^-_3(aq) + 2Cl^-(aq)$ is an example of (2001)

(A) oxidation reaction
(B) reduction reaction
(C) disproportionation reaction
(D) decomposition reaction

η-factor of Oxidation or Reduction half Reaction

$$\overset{+p}{A_x B_y} \longrightarrow \overset{+q}{A_{x_1} B_{y_1}}$$

$p < q \rightarrow$ oxidation

$p > q \rightarrow$ Reduction

η-factor of $A_x B_y = x\,|p-q|$

η-factor of $A_{x_1} B_{y_1} = x_1\,|q-p|$

*** $\overset{+6}{Cr_2}O_7^{-2} \longrightarrow \overset{+3}{Cr^{+3}}$ (Acidic or Basic)

└→ n factor $Cr_2O_7^{-2} = 2|6-3| = 6$

*** $K\overset{+7}{Mn}O_4 \longrightarrow \overset{+2}{Mn^{+2}}$ (Acidic Med)

└→ n-factor of $KMnO_4 = 1|7-2| = 5$

$K\overset{+7}{Mn}O_4 \longrightarrow \overset{+4}{Mn}O_2$ (neutral med.)

n-factor of $KMnO_4 = 1|7-4| = 3$

$K\overset{+7}{Mn}O_4 \longrightarrow K_2\overset{+6}{Mn}O_4$ (Basic med.)

n-factor of $KMnO_4 = 1|7-6| = 1$

$K\overset{+7}{Mn}O_4 \longrightarrow \overset{+4}{Mn}O_2$ (Strong Basic Med)

n-factor of $KMnO_4$

$= 1|7-4| = 3$

Ex → $\overset{+3}{H_2C_2O_4} \longrightarrow \overset{+4}{CO_2}$

↳ $2|3-4| = 2$

Ex → $\overset{0}{I_2} \longrightarrow \overset{+5}{IO_3^-}$

↳ $2|0-5| = 10$

Ex → $H_2\overset{-2}{S} \longrightarrow \overset{0}{S}$

↳ $1|-2-0| = 2$

Ex → $Na_2\overset{+2}{S_2}O_3 \longrightarrow Na_2\overset{+2.5}{S_4}O_6$

↳ $2|2-2.5| = 1$

Q → η-factor of P_4

$\overset{0}{P_4} \longrightarrow \overset{+5}{H_3PO_4}$

a) 20 ✓

b) 4

c) 10

d) 15

η-factor of $P_4 = 4|0-5|$
$= 20$

n-factor of oxidation or Reduction (half Reaction)

total No. of oxidation Number change or total e^- transfer for 1mole compound oxidise | Reduce.

Csd

$$\overset{+p}{A_x}B_y \longrightarrow \overset{+q}{A_{x_1}}B_{y_1}$$

No. of e^- transfer or total oxid^n No change or n-factor

$$= x|p-q|$$

Q → total e transfer in 1 mole $K_2Cr_2O_7$

$\overset{+6}{K_2Cr_2O_7} \longrightarrow \overset{+3}{Cr^{+3}}$

a) 3

η-factor = 2|6−3| = 6

✓ b) 6

c) 9

d) 2

Q → total oxidation change for 1 mole S_8 molecule

Convert into H_2SO_4

$$\overset{0}{S_8} \longrightarrow H_2\overset{+6}{S}O_4$$

a) 8 $8|0-6| = 8 \times 6 = 48$

b) 48 ✓

c) 40

d) 32

. One mole of N_2H_4 loses 10 mole of electrons to form a new compound Y. Assuming that all nitrogen appears in the new compound, what is the oxidation state of N in Y (there is no change in the oxidation state of hydrogen).

(a) −3
(b) +3
(c) +5
(d) +1

$\overset{-2}{N_2H_4} \longrightarrow \overset{+x}{Y} + 10e^-$

$n = 10$

$x = +3$

$x = +7$

$n\text{-factor} = 2|-2-x|$

$10 = 2|-2-x|$

$|-2-x| = 5$

$\overset{-2 \longrightarrow (5) \longrightarrow +x}{N_2H_4 \longrightarrow Y + 10e^-}$

$= 2 \times (5)$

$-2 \quad -1 \quad 0 \quad +1 \quad +2 \quad +3$

η-factor of molecule, when more than one atom oxidise or reduce

Csd

$$\overset{+p}{A}_x \overset{+r}{B}_y \longrightarrow \overset{+q}{A}_{x_1} \overset{+s}{B}_{y_1}$$

$p < q$, $r < s$ → oxidation

$p > q$, $r > s$ → Reduction

η-factor of $A_xB_y = x|p-q| + y|r-s|$

Ex → $\overset{+2}{Fe}\overset{+3}{C_2}O_4 \longrightarrow \overset{+3}{Fe^{+3}} + \overset{+4}{C}O_2$

Ferrous oxilate $1|2-3| + 2|3-4|$
$= 3$

$FeC_2O_4 \rightarrow Fe^{+2} + \overset{+3}{C_2}O_4^{-2}$

$\overset{+1}{Fe_2}\overset{-2}{S} \longrightarrow \overset{+2}{Fe^{+2}} + \overset{+4}{S}O_2$

η-factor of $Fe_2S = 2|1-2| + 1|-2-4|$
$= 2+6 = 8$

Q → $\overset{+1}{Cu_2}\overset{-2}{S} \longrightarrow \overset{+2}{Cu^{+2}} + \overset{+6}{SO_4^{-2}}$ $x|p-q|+y|r-s|$

η-factor Cu_2S $|-8| = (8)$ $S^{-2} \rightarrow$ sulphide

a) 10 $\eta = 2|1-2| + 1|-2-6|$ $2x - 2 = 0$

$= 2 + 8 = 10$ $x = +1$

b) 8

c) 6

d) 12

η-factor of molecule, which undergo disproportionation Redox rxn

$$\overset{0}{Br_2} + OH^- \longrightarrow \overset{-1}{Br^-} + \overset{+5}{BrO_3^-} + H_2O$$

Red^n: $2|0+1| = 2$

oxd^n: $2|0-5| = 10$

η-factor of Br_2 = $\frac{2\times10}{2+10} = \frac{20}{12} = \frac{5}{3}$

$x|p-r| = n_1$

$+p \rightarrow x|p-q| = n_2 \rightarrow +q$; $+r$

$$A_xB_y \longrightarrow A_{x_1} + A_{x_2}$$

$p > q \rightarrow$ Red^n, $p < r \rightarrow$ oxid^n

η-factor of A_xB_y = $\frac{n_1 \times n_2}{n_1 + n_2}$

Q → $\overset{-1}{H_2O_2} \longrightarrow \overset{-2}{H_2O} + \overset{0}{O_2}$

$x|p-q|$

$2|-1-(-2)|$

Red^n: $2|-1+2| = 2$

oxd^n: $2|-1-0| = 2$

n-factor of H_2O_2

a) 1 ✓

n-factor $= \frac{2 \times 2}{2+2} = \frac{4}{4} = 1$

b) 2

c) 4

d) 3

Q $\overset{0}{P_4} \longrightarrow \overset{-3}{PH_3} + NaH_2\overset{+1}{P}O_2$

$4|0+3| = 12$

n-factor of P_4

$4|0-1| = 4$

a) 10

b) 12

$n = \frac{12 \times 4}{12+4} = \frac{48}{16}$ 3

c) 15/4

d) NONE ✓

$n = 3$

Q → $S \longrightarrow S^{-2} + S_2O_3^{-2}$

Oxidation states: S = 0, S^{-2} = −2, $S_2O_3^{-2}$ = +2

n-factor of 'S'

Red^n: $1|0+2| = 2$

Oxd^n: $1|0-2| = 2$

a) 6

b) 4

c) 3

d) NONE ✓

$$n\text{-factor of } S = \frac{2\times 2}{2+2} = \frac{4}{4} = 1$$

Balancing of Redox Reaction

$$\overset{+7}{MnO_4^-} + \overset{+2}{Fe^{+2}} \longrightarrow \overset{+3}{Fe^{+3}} + \overset{+2}{Mn^{+2}} \quad \text{(Acidic Med.)}$$

Oxdⁿ ($Fe^{+2} \rightarrow Fe^{+3}$): $1|2-3| = \textcircled{1}$

Redⁿ ($MnO_4^- \rightarrow Mn^{+2}$): $1|7-2| = \textcircled{5}$

Step-1 → Select oxidation & Reduction half Rxn

Step-2 → Calculate n-factor of Oxidation & Reduction molecule

Step-3 n-factor of oxidise molecule → Stoichiometric ceofficient of Reduce mole.

n-factor of Reduce molecule → Stoichiometric Ceofficient of oxidise mole.

$8H^+ + 1\,MnO_4^- + 5\,Fe^{+2} \longrightarrow 5\,Fe^{+3} + 1\,Mn^{+2} + 4\,H_2O$

Step-4 Other atom balance by H&T method

Last me oxygen atom aur H-atom balance Krna

<u>Acidic med</u> → $H \longrightarrow H^+$, $O \longrightarrow H_2O$

<u>Basic med</u> → $H \longrightarrow H_2O$, $O \longrightarrow OH^-$

$8 + 20$

Oxd^n

$2|3-4| = 2$

$$\overset{}{16}H^+ + 2\overset{+7}{Mn}O_4^- + 5\overset{+3}{C_2}O_4^{-2} \longrightarrow 10\overset{+4}{C}O_2 + 2\overset{+2}{Mn}^{+2} + 8H_2O$$

Red

$1|7-2| = 5$

20. For the redox reaction

$$MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O$$

The correct coefficients of the reactants for the balanced reaction are

	MnO_4^-	$C_2O_4^{2-}$	H^+
(A)	2	5	16
(B)	16	5	2
(C)	5	16	2
(D)	2	16	5

. $xClO_4^- + yMnO_2 + zOH^- \longrightarrow xClO^- + yMnO_4^{2-} + \frac{z}{2} H_2O$

In this balanced equation x, y, z are:

(a) 2, 3, 6   (b) 1, 3, 4

(c) 1, 3, 6 ✓   (d) 2, 6, 6

$2+24=26$, $+6$ → 32 $O \rightarrow OH^-$, $H \rightarrow H_2O$

oxd^n → $1|4-6| = 2$

$$\overset{+7}{2ClO_4^-} + \overset{+4}{6MnO_2} + 12OH^- \longrightarrow \overset{+1}{2ClO^-} + \overset{+6}{6MnO_4^{-2}} + 6H_2O$$

Red $= 1|7-1| = 6$

$8 + 12 = 20$, $20 + 12 = 32$

$$1ClO_4^- + 3MnO_2 + 6OH^- \longrightarrow ClO^- + 3MnO_4^{-2} + 3H_2O$$

(1 → x, 3 → y, 6 → z)

Q $x\,Cr_2O_7^{-2} + y\,H_2S \longrightarrow S + Cr^{+3}$ (Acidic med.)

+6

Calculate sum of $x+y$

a) 6

→ Home work

b) 5

c) 8

d) NONE

MANTHAN NEET 2025

CHEMISTRY

Redox titration

Lecture-05



Sarvesh Sir

Number of gram Equivalent

It is a number,

$$\text{Mole} = \frac{\text{weight}}{\text{M.wt}}$$

$$\text{No. of gram Eq.} = \frac{\text{weight}}{\text{E.wt}} = \frac{\text{weight}}{\text{M.wt}} \times n\text{-factor}$$

$$\text{No. of gram Equivalent} = \text{Mole} \times n\text{-factor}$$

$$\text{E.wt} = \frac{\text{M.wt}}{n\text{-factor}}$$

Q → How many gram Equivalent present in 2 mole of H_2SO_4

a) 1

b) 2

c) 3

d) 4

No. of gram Eq = mole × n-factor

= 2 × 2 = 4

Normality

total No. of gram Equivalent of solute dissolve in 1 litre of solution

$$N = \frac{\text{No. of gram Eq. of solute}}{\text{Volume of sol}^n \text{ (L)}}$$

$$\text{No. of gram Eq. of solute} = N \times V(L)$$

$$\text{unit of normality} = \frac{\text{gram Eq.}}{\text{litre}}$$

Q → 9.8 gram H_3PO_4 acid dissolve in 500 ml water.

Calculate Normality of solution.

a) 0.2 N

b) 0.1 N

c) 0.4 N

d) NONE

$$N = \frac{\text{No. of gram Eq.}}{\text{Vol. of soln}} = \frac{0.3}{500 \times 10^{-3}} = \frac{0.3 \times 1000}{500} = 0.6$$

$$\text{No. of gram Eq.} = \text{mole} \times n = \left(\frac{9.8}{98}\right) \times 3 = 0.3$$

Relation between N & M

$$M = \frac{\text{mole}}{V_{soln}} \quad \text{—— (I)}$$

$$N = \frac{\text{No. of gram Eq.}}{V_{soln}} \quad \text{—— (II)}$$

$$\frac{M}{N} = \frac{\text{Mole}}{\text{No. of gram Eq.}} = \frac{\text{mole}}{\eta \times \text{mole}}$$

$$\boxed{N = \eta\text{-factor} \times M}$$

CSD No. of gram Eq. of solute = $\frac{\text{weight}}{\text{E.wt}}$ = mole × η-factor = N × V (L)

$$N = \frac{\text{No. of gram Eq. of solute}}{\text{Volume of solution}}$$

→ N = η-factor × Molarity

Suppose → $A_xB_y \rightleftharpoons xA^{+y} + yB^{-x}$

A_xB_y → Normality = N

Normality of A^{+y} = N.

Normality of B^{-x} = N

Law of Equivalence

Suppose ⇒ A_xB_y

→ No. of gram Eq. of A = No. of gram Eq. of B

→ $\eta_1 A + \eta_2 B \longrightarrow \eta_3 C$

No. of gram Eq. of A = No. of gram Eq. of B =

No. of gram of 'C'

Q→ 0.3 M $Al_2(SO_4)_3$ solution present Container. Calculate Molarity of Al^{+3} and SO_4^{-2} in solution

Sol^n $Al_2(SO_4)_3 = 0.3M$

$M_{Al^{+3}} = 2 \times 0.3 = 0.6M$

$M_{SO_4^{-2}} = 3 \times 0.3 = 0.9M$

Q→ 0.3 N $Al_2(SO_4)_3$ solution present Container. Calculate Normality of Al^{+3} and SO_4^{-2} in solution

N of $Al_2(SO_4)_3 = 0.3N$

$N_{Al^{+3}} = 0.3N$

$N_{SO_4^{-2}} = 0.3N$

Q → How many mole of $KMnO_4$ required to Complete oxidation of 1 mole oxallic acid in given Redox rxn.

$$\overset{+7}{KMnO_4} + \overset{+3}{H_2C_2O_4} \longrightarrow \overset{+2}{Mn^{+2}} + \overset{+4}{CO_2} + K^+$$

$+3 \rightarrow 2|3-4| = 2$

$1|7-2| = 5$

a) 5 mole

b) $\frac{2}{5}$ mole ✓

c) $\frac{5}{2}$ mole

d) NONE

No. of gram Eq. of $KMnO_4$ = No. of gram Eq. of $H_2C_2O_4$

$$\text{Mole} \times n_{KMnO_4} = \text{Mole} \times n_{H_2C_2O_4}$$

$$\text{Mole} \times 5 = 1 \times 2$$

Mole of $KMnO_4 = 2/5$

7. How many gram of I_2 are present in a solution which requires 40 mL of 0.11 N $Na_2S_2O_3$ to react with it via the reaction

$2S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + 2I^-$?

$+2 \quad 0 \quad +2.5 \quad -1$

$2|0+1| = 2$

$2|2-2.5| = 1$

(a) 12.7g

(b) 0.558 g

(c) 25.4 g

(d) 11.4 g

No. of gram Eq. of I_2 = No. of gram of $Na_2S_2O_3$

$Mole \times n_{I_2} = N \times V(L)$

$Mole \times 2 = 0.11 \times 40 \times 10^{-3}$ (20)

$Mole = 0.11 \times 20 \times 10^{-3}$ mole

$40 \times 10^{-3} \times 0.11$

No. of gram Eq = $N \times V(L)$

$W_{I_2} = 2.2 \times 10^{-3} \times 254$

$= .5588$

$= 0.56$ gram

44

11

Q16. The number of moles of $KMnO_4$ that will be needed to react with one mole of sulphite ion in acidic solution is: [CBSE AIPMT 2007]

(a) 4/5 (b) 2/5

(c) 1 (d) 3/5

$$\overset{+7}{KMnO_4} + \overset{+4}{SO_3^{-2}} \longrightarrow \overset{+2}{Mn^{+2}} + \overset{+6}{SO_4^{-2}} + K^+$$

$1|7-2| = 5$

$1|4-6| = 2$

No. of gram Eq. of $KMnO_4$ = No. of gram of SO_3^{-2}

mole × 5 = 1 × 2

mole = 2/5

Q15. Number of moles of MnO_4^- required to oxidise one mole of ferrous oxalate completely in acidic medium will be [CBSE AIPMT 2008]

(a) 0.6 mole (b) 0.4 mole

(c) 7.5 moles (d) 0.2 mole

$$\overset{+7}{Mn}O_4^- + \overset{+2}{Fe}\overset{+3}{C_2}O_4 \longrightarrow \overset{+2}{Mn^{+2}} + \overset{+3}{Fe^{+3}} + \overset{+4}{CO_2}$$

$1|7-2| = 5$

$1|2-3| + 2|3-4| = 1 + 2 = 3$

No. of gram Eq. of MnO_4^- = No. of gram Eq. of FeC_2O_4

$$\text{Mole} \times 5 = 1 \times 3$$

$$\text{Mole} = 3/5 = 0.6 \text{ mole}$$

8. In the reaction of oxalate with permanganate in acidic medium, the number of electrons involved in producing one molecule of CO_2 is

(Jee-Main 2019)

(A) 2 (B) 5

(C) 1 (D) 10

n-factor = e^- transfer
= net oxidation No.

$$\overset{}{MnO_4^-} + \overset{+3}{C_2}O_4^{-2} \longrightarrow Mn^{+2} + \overset{+4}{C}O_2$$

n-factor of CO_2 = $1|4-3| = 1$

Q18. The number of moles of $KMnO_4$ reduced by one mole of KI in alkaline medium is [CBSE AIPMT 2005]

and

NEET-2022

(a) one fifth (b) five

(c) one (d) two ✓

$$\overset{+7}{KMnO_4} + \overset{-1}{KI} \longrightarrow \overset{+4}{MnO_2} + \overset{+5}{IO_3^-} + K^+$$

KI → IO_3^-: $1|-1-5| = 6$

$KMnO_4$ → MnO_2: $1|7-4| = 3$

?

$$\text{mole} \times n_{KMnO_4} = \text{mole} \times n_{KI}$$

$$\text{mole} \times 3 = 1 \times 6$$

$$\boxed{\text{Mole} = 2}$$

5. The anion nitrate can be converted into ammonium ion. The equivalent mass of NO_3^- ion in this reaction would be

(a) 6.20 g
(b) 7.75 g
(c) 10.5 g
(d) 21.0 g

$1|5+3| = 8$

$\overset{+5}{N}O_3^- \longrightarrow \overset{-3}{N}H_4^+$

14
48
62

E.wt = ?

$E.wt = \frac{M.wt}{n} = \frac{62}{8} = 7.75g$

23. The equivalent weight of $MnSO_4$ is half of its molecular weight, when it converts to (1988)

(A) Mn_2O_3 (B) MnO_2

(C) MnO^-_4 (D) MnO_4^{2-}

NEET-2025---

$1|2-7|=5$ $MnSO_4 \rightarrow E.wt = \frac{M.wt}{2} = \frac{M.wt}{n}$ $1|2-6|=4$ $Eq. = \frac{M.wt}{2}$

$n = 2$

$+2 - 1|2-3| = 1$ $+3$

$MnO_4 \longrightarrow Mn_2O_3$

$+4$

$1|2-4|=2 \longrightarrow MnO_2$

$MnSO_4 \longrightarrow Mn_2O_3$

$MnSO_4 \rightarrow MnO_2$

$MnSO_4 \rightarrow MnO_4^-$

$MnSO_4 \rightarrow MnO_4^{-2}$

$Eq. = \frac{M.wt}{n}$

$n = 2$

Q → 1 mole H_2S Convert in 'S' atom in react with x mole of $K_2Cr_2O_7$ in acidic med.

$$H_2\overset{-2}{S} + K_2\overset{+6}{Cr_2}O_7 \longrightarrow Cr^{+3} + \overset{0}{S} + H_2O + K^+$$

$2|6-3| = 6$

$1|-2-0| = 2$

Calculate value of x

a) 1 mole

b) 2 mole

c) 1/6 mole

d) NONE

No. of gram Eq. of H_2S = No. of gram Eq. of $K_2Cr_2O_7$

$1 \times 2 = x \times 6$

$x = 1/3$

Q → which one molecule | ions oxidise as well as Reduce

a) $\overset{+5}{NO_3^-}$ → X

b) $\overset{+4}{SO_3^{-2}}$

c) $\overset{+7}{ClO_4^-}$ → X

d) All

+4 → (+6)

(0) → S

−2 → S^{-2}

Concept → oxidise = oxdⁿ No increase

Reduce = oxdⁿ No. decrease

Electro-chemistry

you tube → Lec-③

7:00pm

Mon → Fri

THANK YOU

All the Best!! 👍

SANKALP NEET VEDANTU

MANTHAN NEET 2025

Manthan → 31, 1, 2 3 (sunday)
30 (Bio-only) → Chhutti

CHEMISTRY

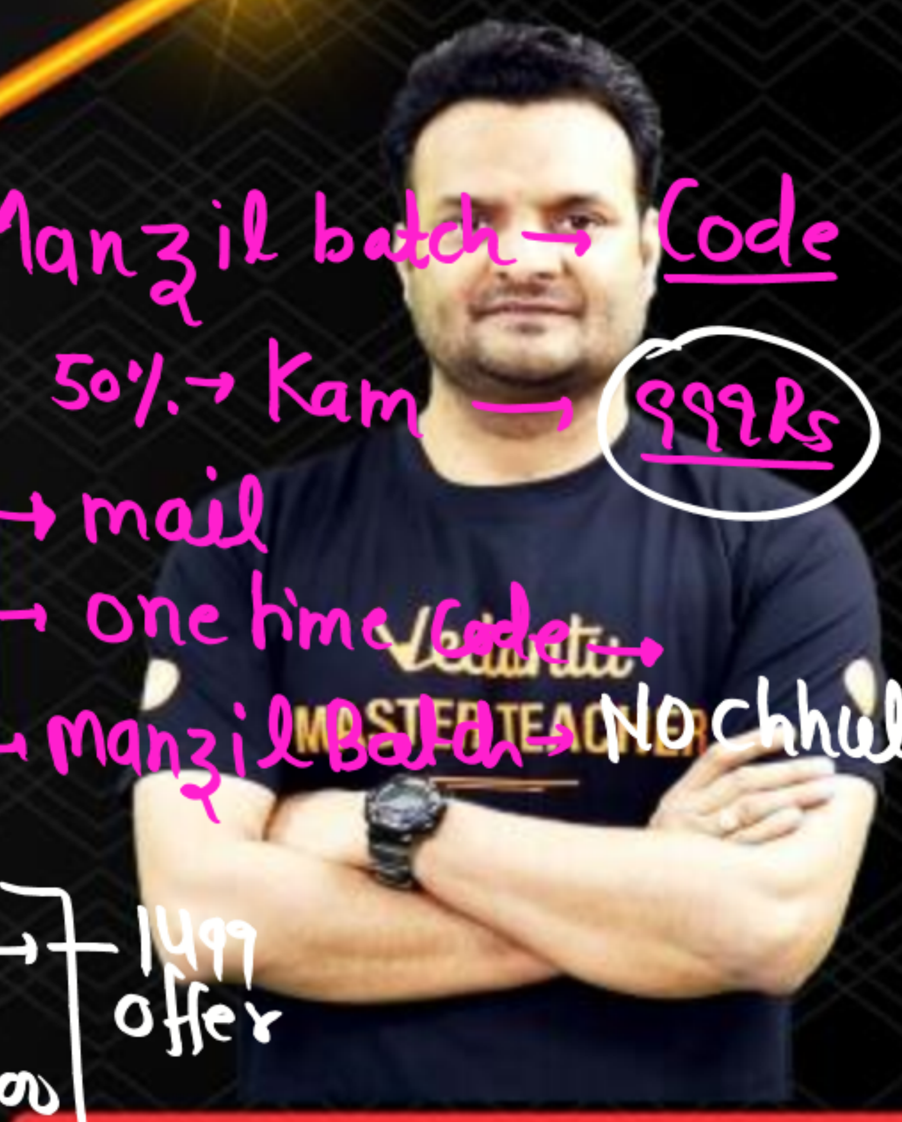
ELECTROCHEMISTRY

→ Manzil batch → Code
50% → Kam → 999Rs
→ mail
→ one time code →
→ Manzil Batch → NO Chhutti

Diwali ⇒ U-tube

Test series → 1499 offer
Tejas → 1600
Combo

Lecture-01



Sarvesh Sir

Today's Goal -

Conductance

Classification of conductance

Effecting factor

Kohlrausch's law



ELECTROLYTE

Solution or solvent → having ions = Electrolyte

Solution or solvent → not ions present in solution or solvent = Non-electrolyte

Ex → aq. NaCl → $Na^+ + Cl^-$

Ex → aq. HCl → $H^+ + Cl^-$

Ex → aq $CH_3COOH \rightarrow CH_3COO^- + H^+$

Acid, Base, Salt } ionisation

$H_2O \rightleftharpoons H^+ + OH^-$

Benzene liq → Nonelectrolyte

glucose → nonelectrolyte

Select non electrolyte solution in given example

(a) NaCl(aq) (b) KCl(aq) (c) glucose (d) CH_3COOH

$Na^+ + Cl^-$ $K^+ + Cl^-$ ✗ $CH_3COO^- + H^+$

(A) a

(B) b

(C) c

(D) d

Electrolyte

Weak electrolyte	Strong electrolyte
→ partially ionise	→ Competel ionise
→ poor-ionise	→ 100% approx
→ 1 to 20%	→ S.A, S.B, Salt → H_2SO_4, HNO_3, HI, HBr, HCl, $HClO_4$, NaOH, KOH, $Ca(OH)_2$, $Ba(OH)_2$

Ex W.A, W.B → all org. acid & org base

Solvent → H_2O, NH_3

Select weak electrolyte solution in given example

(a) NaCl(aq) (b) HCl(aq) (c) glucose (d) CH_3COOH

↳ Salt | S.A. | Non electrolyte | W.A. ↓ weak electrolyte

(A) a

(B) b

(C) c

(D) d ✓

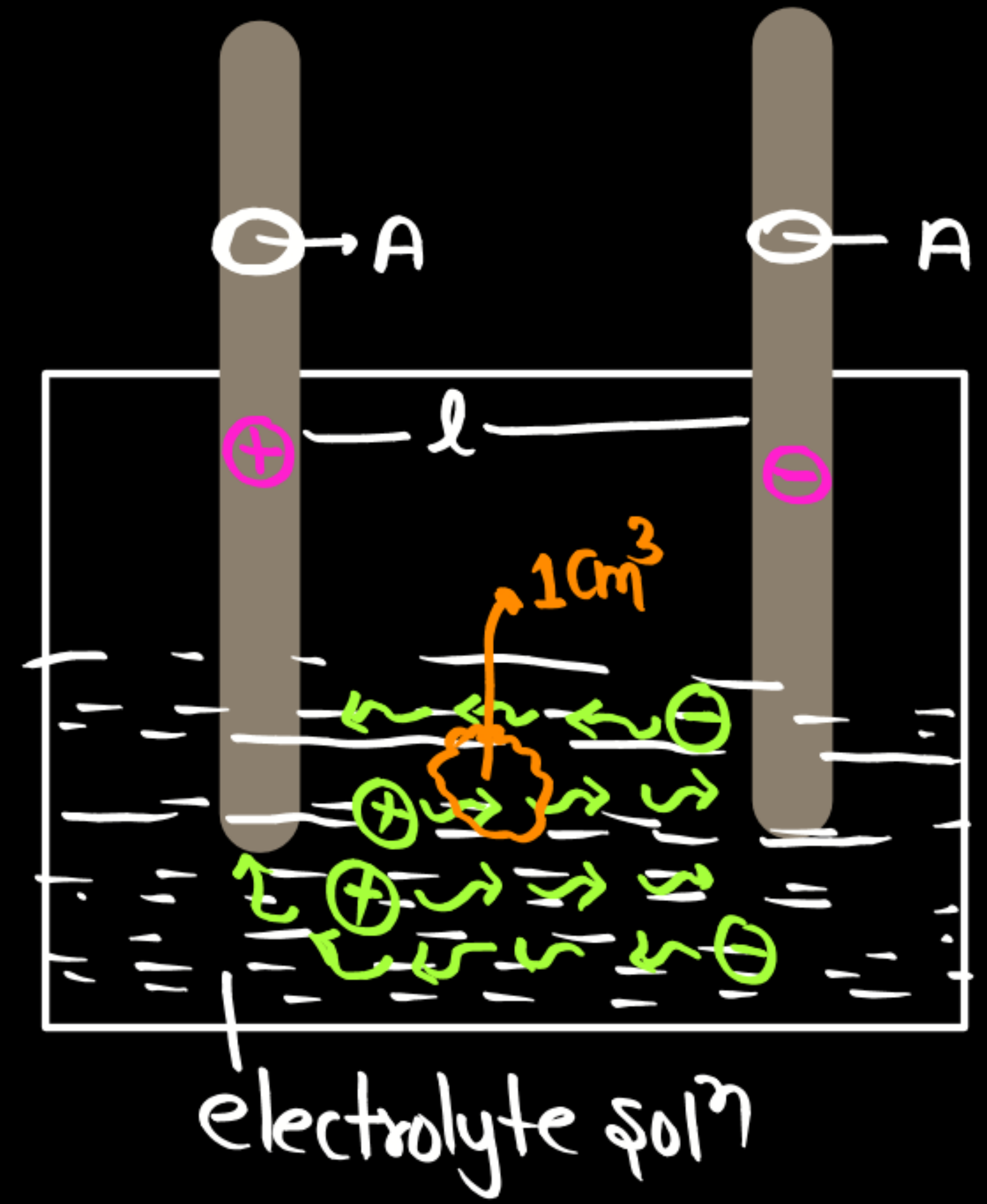
CONDUCTANCE

It is measure rate of flow of charge in electrolyte solution (cell)

→ formula ⇒ $C \text{ or } G = \frac{1}{R}$, R → Resistance

→ Represent → C or G

→ unit = $\frac{1}{\Omega} = \Omega^{-1}$ or Siemen's (S)



EFFECTING FACTOR

1) <u>No. of ions</u>

Conductance $\propto$ No. of ions

Q → a) 1 mole NaCl = 2 mole ions

b) 2 mole NaCl = 4 mole ions

Cond^c → a > b – (i)

✓ b > a → ii

Q → a) 1 mole HCl → S.A → 100%

b) 1 mole CH_3COOH → W.A. → 3%

Cond^c → (i) – a > b ✓

(ii) → a < b

CSD $C = \frac{1}{R}$

→ Represent → C or G

→ unit → Ω^{-1} or Siemen's (S)

→ Cond^c ∝ No. of ions

→ Cond^c → strong electrolyte > weak electrolyte

→ Cond^c ∝ Acidic strength of acid

→ Cond^c ∝ basic strength of base

→ Cond^c ∝ size of ions (Note → No. of ions - same ho) (sabse last me) gaseous ion size

→ Note → $H^+ >> $ Cation, $OH^- >>$ Anion

Reason = Due to GROTHUS EFFECT

→ $K = \frac{1}{\rho}$ (Resistivity), $K = C \times \left(\frac{l}{A}\right)$

→ $\lambda_m = \frac{K \times 10^3}{M}$ → $\lambda_m \propto \frac{1}{M}$

$\lambda_e = \frac{K \times 10^3}{N}$, $\lambda_e \propto \frac{1}{N}$

Select the electrolyte, which has maximum conductance.

A. 0.1 M CH_3COOH → W.A.

B. 0.1 M glucose – Non electrolyte

C. 0.01 M C_6H_5COOH → W.A.

D. 0.3 M HCl – S.A. ✓

Select the electrolyte, which has maximum conductance.

(A) 0.1 M $CaCl_2$ → 3 ion = 0.3 M

(B) 0.1 M NaCl – 2 ion → 0.2 M

(C) 0.01 M $CaCl_2$ → 3 ion → 0.03 M

(D) 0.3 M AlF_3 → 4 ion = .3 × 4 = 1.2 M

Ex → a) 0·1 M CH_3COOH

b) 0·1 M 

Cond^c = order = ? → b) > a

Cond^c ∝ Acidic strength

→ Aromatic acid > Aliphatic acid (Except - HCOOH)

 > CH_3COOH

Q → HCOOH, CH_3COOH

CH_3CH_2COOH, max. Cond^c

a) HCOOH ✓

b) CH_3COOH

c) CH_3CH_2COOH

d) All equal

Ex → Li^+ , K^+ , Cs^+

Sol^n → Cond^c → $Cs^+ > K^+ > Li^+$

Ex → NaCl , KCl

Sol^n → $KCl > NaCl$

Ex → NaCl , NaBr

Cond^c → $Br^- > Cl^-$

$NaBr > NaCl$

Arrange increasing order of conductance of following given example

(a) $NaCl(aq)$ (b) $KCl(aq)$ (c) $CsCl(aq)$

Cond^c ∝ size

c > b > a

A. a > b > c

B. a > c > b

C. c > b > a

D. b > c > a

Arrange increasing order of conductance of following given example for 1M each

(a) $AlCl_3(aq)$ (b) $MgCl_2(aq)$ (c) $CsCl(aq)$

4 ion 3 ion 2 ion

$Al^{+3} < Mg^{+2} < Cs^{+}$

(A) a > b > c

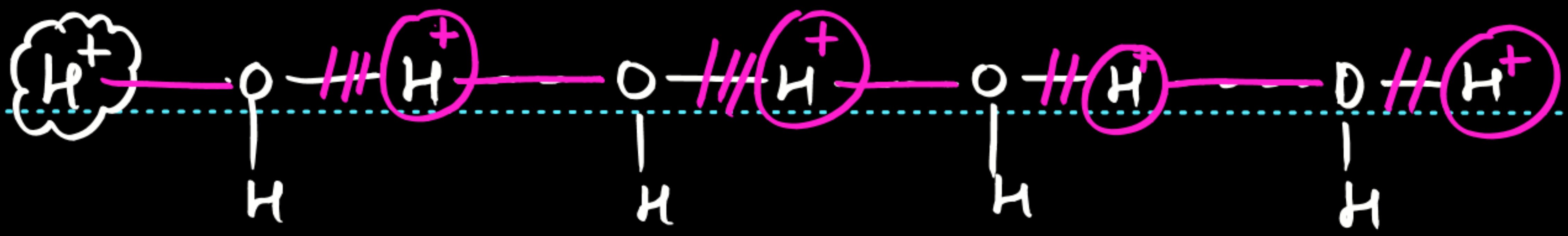
Cond^c ∝ No. of ions

(B) a > c > b

a > b > c c < b < a

(C) c > b > a

(D) b > c > a



Q → a) 1 mol HCl → HCl > NaCl

b) 1 mole NaCl

Cond^c max

i) a

ii) b

Select the pair of electrolyte, In which 1st electrolyte is more conductance than second electrolyte.

(A) 0.1 M HCl, 0.1 M NaCl

(B) 0.1 M NaCl, 0.1 M HCl

(C) 0.1 M $CaCl_2$, 1 M $CaCl_2$

(D) None of these

Q → Select the compound which have max Cond^c

a) NaCl – S.E

b) ✓ HCl – S.E → $H^+ > Na^+$

c) ✗ CH_3COOH – W.E

d) ✗ $C_6H_{12}O_6$ → NON.E

SPECIFIC CONDUCTANCE OR CONDUCTIVITY

It is measure rate of flow of charge in $1 cm^3$ electrolyte solution

or

Conductance per cm^3 volume is known as conductivity

Represent = κ (Kappa)

* unit of $\kappa = S \times cm^{-1}$

$\frac{cm}{cm^2}$

formula → $\kappa = \frac{1}{\rho}$ → Resistivity

$R \propto \frac{l}{A}$ → $R = \rho \frac{l}{A}$ ⇒ $\frac{1}{\rho} = \frac{1}{R}\left(\frac{l}{A}\right)$ → $\kappa = C \times \frac{l}{A}$ (cell const.)

$\kappa = C \times \text{cell Const}$

Q40. The specific conductance of a 0.1 N KCl solution at 23°C is 0.012 Ω^{-1} cm^{-1}. The resistance of cell containing the solution at the same temperature was found to be 55Ω. The cell constant will be

(a) 0.142 cm^{-1}

(b) 0.66 cm^{-1}

(c) 0.918 cm^{-1}

(d) 1.12 cm^{-1}

$C = \frac{1}{R} = \frac{1}{55}$

$\kappa = C \times \text{cell const}$

$0.012 = \frac{1}{55} \times \text{cell const}$

$\text{Cell const} = 0.012 \times 55$

$= .660 \ cm^{-1}$

MOLAR CONDUCTANCE

electrolyte solⁿ = 1M

It is measure rate of flow of charge in 1 Molar (1M) electrolyte Solution

Represent → λ_m

formula → $$\lambda_m = \frac{K \times 10^3}{M}$$

unit of λ_m = $$\frac{S \cdot cm^{-1}}{\frac{mole}{cm^3}} = \frac{S \cdot cm^{-1} \times cm^3}{mole} = S \cdot cm^2\, mole^{-1}$$

λ_m M

Q3. The molar conductivity of a 0.5 mol/dm³ solution of $AgNo_3$ with electrolytic conductivity of 5.76×10^{-3} S cm^{-1} at 298 K is

K

$1\,dm^3 = 1L = 10^3\,cm^3 = 10^{-3}\,m^3$]

(a) 2.88 S cm²/mol

(b) 11.52 S cm²/mol

(c) 0.086 S cm²/mol

(d) 28.8 S cm²/mol

$$\lambda_m = \frac{K \times 10^3}{M} = \frac{5.76 \times 10^{-3} \times 10^3}{0.5}$$

$$= \frac{57.6}{5} = 11.5\ \frac{S\,cm^2}{mole}$$

EQUIVALENT CONDUCTANCE

Electrolyte solution = 1 Normal → Normality = 1N → Cond^c → Eq. Cond^c

→ It is measure rate of flow of charge in 1 Normal (1N) electrolyte solution

Represent → λ_e

formula → $$\lambda_e = \frac{K \times 10^3}{N}$$

unit → $$\lambda_e = \frac{S \cdot cm^{-1}}{\frac{gram\ Eq.}{cm^3}} = \frac{S \cdot cm^2}{gram\ Eq.}$$

RELATION BETWEEN λ_m & λ_e

Thank you!

MANTHAN NEET 2025

CHEMISTRY

ELECTROCHEMISTRY

Lecture-02



→ 30 Oct → u-tube
11th Complete
→ 4pm → live

→ 2hr

Sarvesh Sir

SANKALP NEET VEDANTU

Today’s Goal -

Conductance
Classification of conductance
Effecting factor
Kohlrausch's law

RELATION BETWEEN λ_m & λ_e

$$\lambda_m = \frac{K \times 10^3}{M} \quad \text{—— (1)}$$

$$\lambda_e = \frac{K \times 10^3}{N} \quad \text{—— (2)}$$

$$\frac{(1)}{(2)} \Rightarrow \frac{\lambda_m}{\lambda_e} = \frac{N}{M} = \frac{\eta\text{ factor} \times M}{M}$$

$$\frac{\lambda_m}{\lambda_e} = \eta\text{-factor}$$

$$\boxed{\lambda_m = \eta\text{-factor} \times \lambda_e}$$

η-factor

η-factor of Ion (Cation or Anion

= Charge of Ion

$Zn^{+2} \rightarrow 2$, $Al^{+3} \rightarrow 3$, $Zr^{+4} = 4$

$SO_4^{-2} = 2$, $PO_4^{-3} = 3$, $OH^{-} = 1$

η-factor of salt = total +ve charge or total −ve charge

$NaCl \rightarrow \eta = 1$

$Na_2SO_4 \rightarrow \eta = 2$

$Al_2(SO_4)_3 \rightarrow \eta = 6$

$K_2SO_4 \cdot Al_2(SO_4)_3 \rightarrow \eta = 8$

+2   +6

Q → Eq. Cond^c of Al^{+3} is 50 $S\,cm^2\,Eq^{-1}$ than cal. $\lambda_m = ?$

a) 50   b) $\frac{50}{3}$ c) 50×3   d) NONE

$\lambda_m = \eta \times \lambda_e = 3 \times 50\ S\,cm^2\,mole^{-1}$

Q → λ_m of $Ca_3(PO_4)_2 = 50\ S\,cm^2\,mole^{-1}$, $\lambda_e = ?$

a) 50   b) $\frac{50}{3}$ c) 50×3   d) NONE

$50 = 6 \times \lambda_e \Rightarrow \lambda_e = \frac{50}{6}$

Q Eq. Cond^c of $ZnCl_2$ is 120 $S\,cm^2\,Eq^{-1}$, Calculate Λ_m of $ZnCl_2$ sol^n.

$$\Lambda_m = n \times \Lambda_e = 2 \times 120 = 240\ S\,cm^2\,mole^{-1}$$

a) 60

b) 240

c) 120

d) 100

EFFECT OF DILUTION In Conductance

Dilution = only addition of solvent (water)

Con. = $\frac{\text{Mole}}{\text{Vol.}}$ ⇒ dilution = vol. -increase

↓ Concentration $\propto \frac{1}{\text{dilution}\uparrow}$

Dilution or Con. of solⁿ decrease krna

→ 1) $\uparrow\alpha = \sqrt{\frac{K_a}{C\downarrow}}$ ⇒ No. of ions increases

2) distance b/w ions → increases

(+) —F_A— (−) ⇒ $F_A \propto \frac{1}{\text{dist}^n}$

→ λ_m, λ_e & Cond^c (C) increases on dilution or decreasing in Concentration

→ <u>Note</u> → but Conductivity (K) decrease on dilution or decreases in Con.

<u>Reason</u> = No. of ions per cm^3 decreases,

0.3 M CH_3COOH diluted 10 times, than select correct statement.

(A) Conductance increases

(B) Conductance decreases

(C) No effect (remains same)

(D) All are correct

53. Consider the statements S_1 and S_2:

S_1 : Conductivity always increases with decrease in the concentration of electrolyte.

S_2 : Molar conductivity always increases with decrease in the concentration of electrolyte.

The correct option among the following is

(A) S_1 is correct and S_2 is wrong

(B) S_1 is wrong and S_2 is correct

(C) Both S_1 and S_2 are wrong

(D) Both S_1 and S_2 are correct

EFFECT OF DILUTION ON STRONG ELECTROLYTE

→ Cond^c of strong electrolyte increases on dilution or decrease in Con.

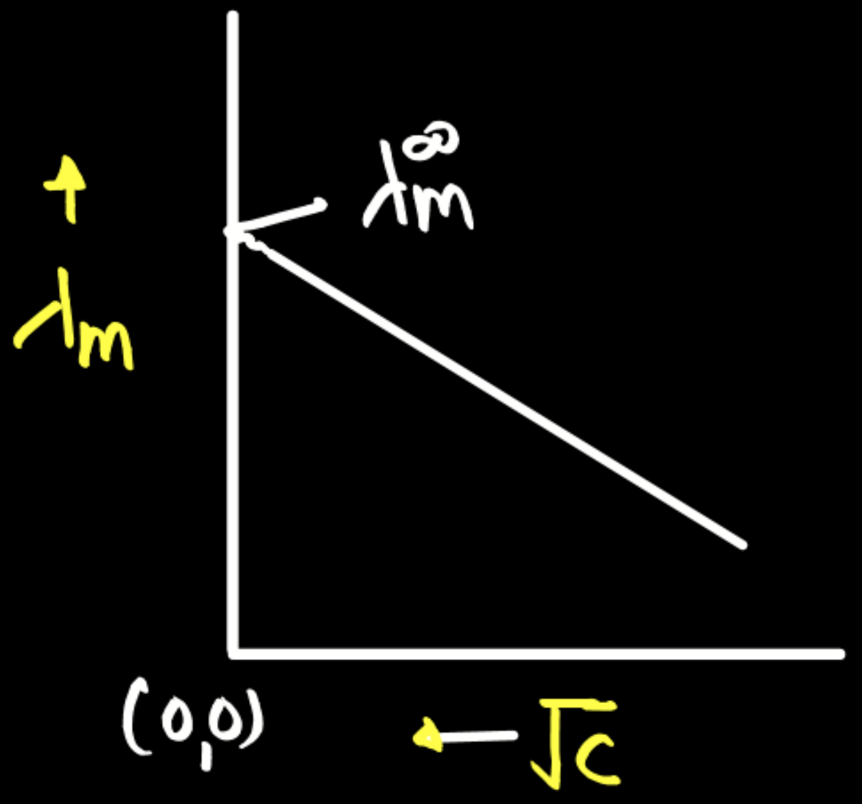
Reason

① No. of ions → increases (Kam increase Karenge)

② dist^n b/w ions increases

$$\lambda_m^v = \lambda_m^\infty - B\sqrt{C}$$ → Onsagar, Huckel and Debye

$$y = c + (-m)x$$



λ_m^v = molar Cond^c at finite Con. (finite dilution)

λ_m^∞ = molar Cond^c at infinite dilution (Con → 0)

C = Con. of electrolyte

B = Const (solute & solvent → depend)

63. The equivalent conductance of NaCl at concentration C and at infinite dilution are λ_C and λ_∞, respectively. The correct relationship between λ_C and λ_∞ is given as (where, the constant B is positive)

(A) $\lambda_C = \lambda_\infty + (B)\, C$

(B) $\lambda_C = \lambda_\infty - (B)\, C$

(C) $\lambda_C = \lambda_\infty - (B)\sqrt{C}$

(D) $\lambda_C = \lambda_\infty + (B)\sqrt{C}$

$\lambda_c = \lambda_\infty - B\sqrt{C}$

Q20. An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to

(a) increase in ionic mobility of ions

(b) 100% ionisation of electrolyte at normal dilution

(c) increase in both, i.e., number of ions and ionic mobility of ions

(d) increase in number of ions

71. The correct order of equivalent conductance at infinite dilution of LiCl, NaCl and KC1 is

Cond^c $\propto$ size → KCl > NaCl > LiCl

(A) LiCl > NaCl > KCl

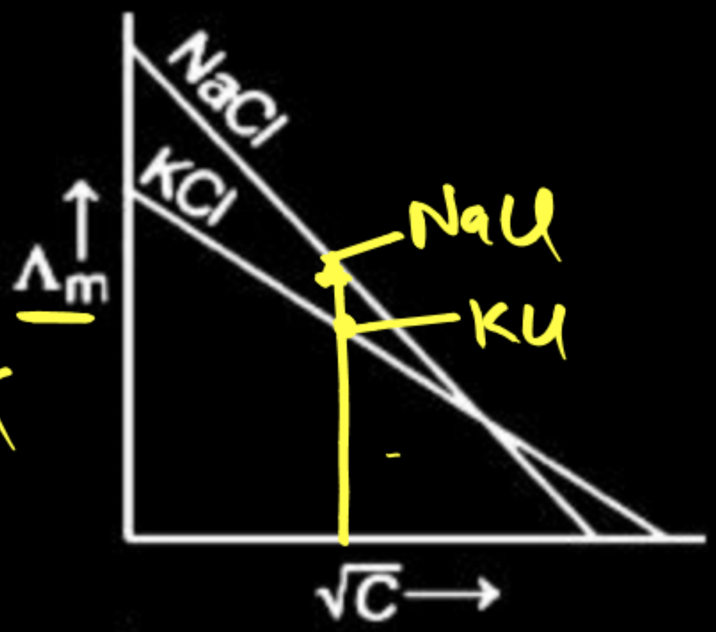
(B) KCl > NaCl > LiCl

(C) NaCl > KCl > LiCl

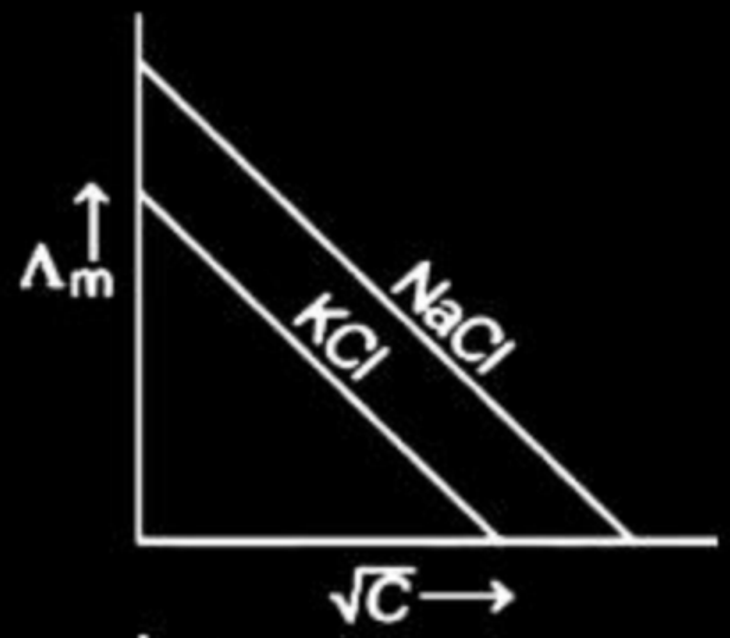
(D) LiCl > KCl > NaCl

52. Which one of the following graphs between molar conductivity (Λ_m) versus $\sqrt{C}$ is correct?

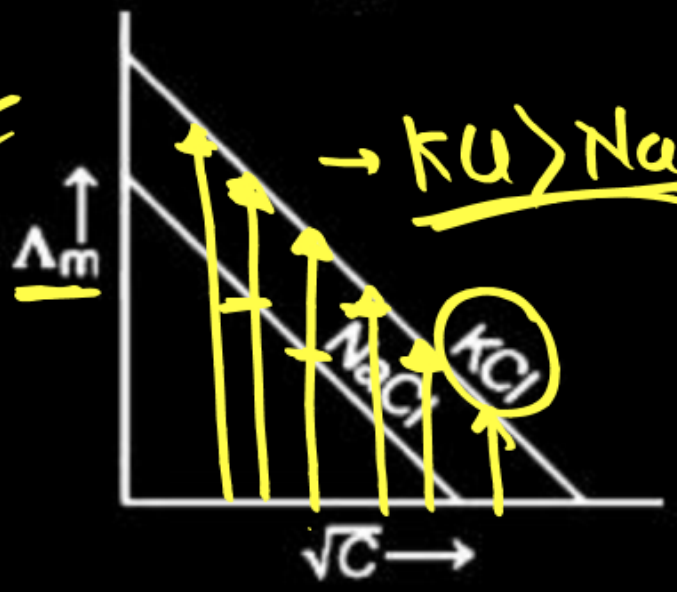
(A)



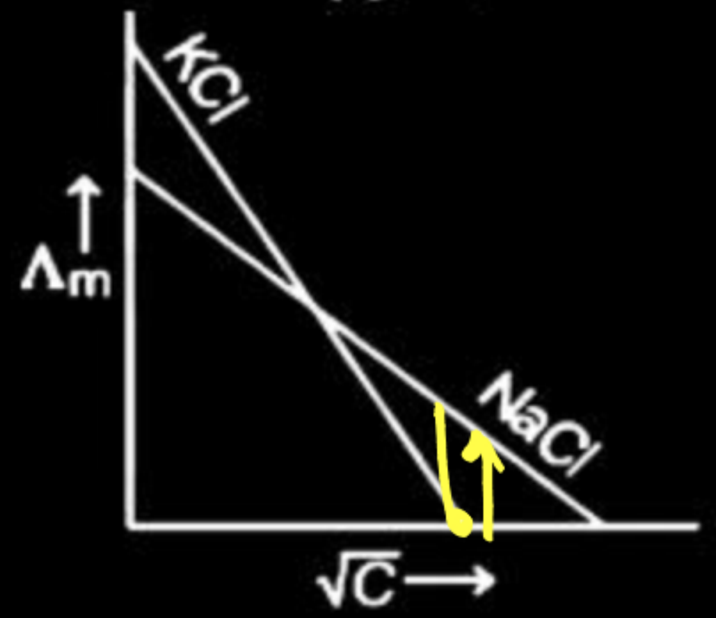
(B)



(C)



(D)



EFFECT OF DILUTION ON WEAK ELECTROLYTE

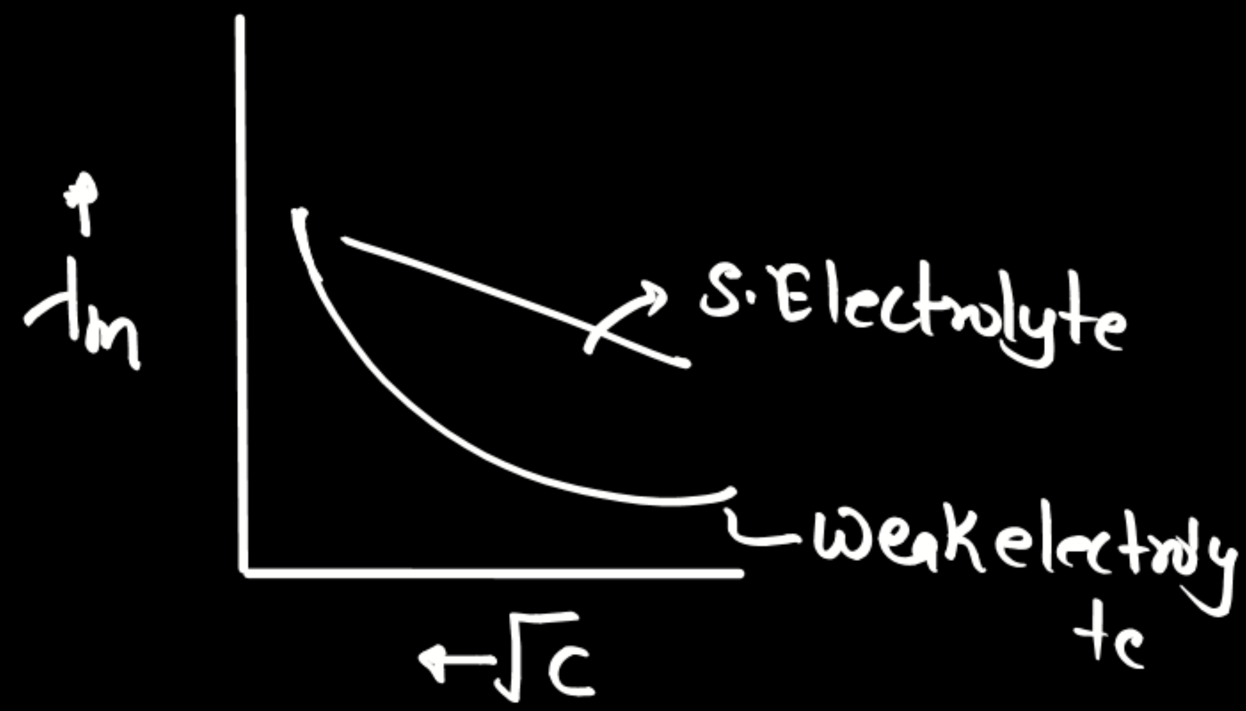
(Kohlrausch's law)

→ Cond^c of weak electrolyte highly increases on dilution or decreases in Con. of electrolyte

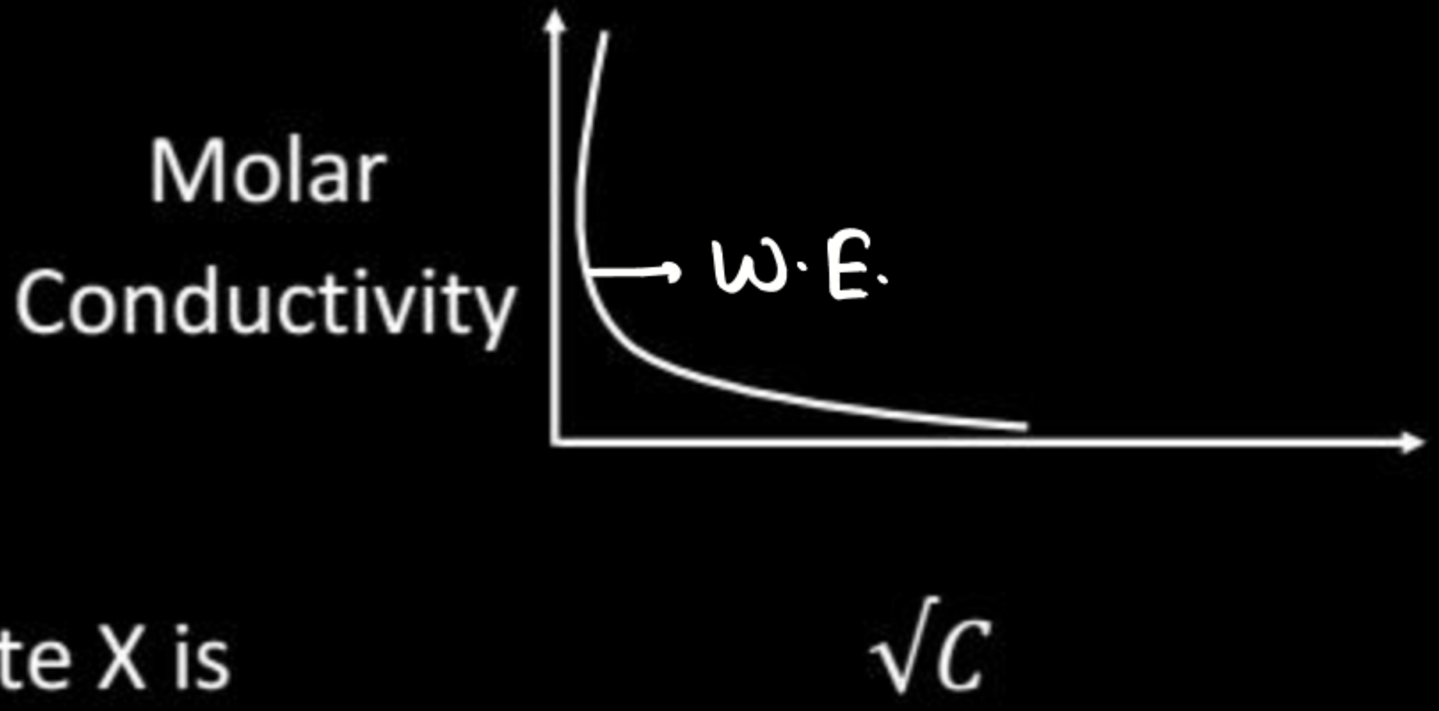
1) No. of ions = large No. me increase honge

2) distance b/w ions also increases

$\alpha = \sqrt{\frac{K_a}{C}} \rightarrow K_a = C\alpha^2$



Q. The variation of molar conductivity with concentration of an electrolyte (X) in aqueous solution is shown in the given figure.



The electrolyte X is

a) NaCl

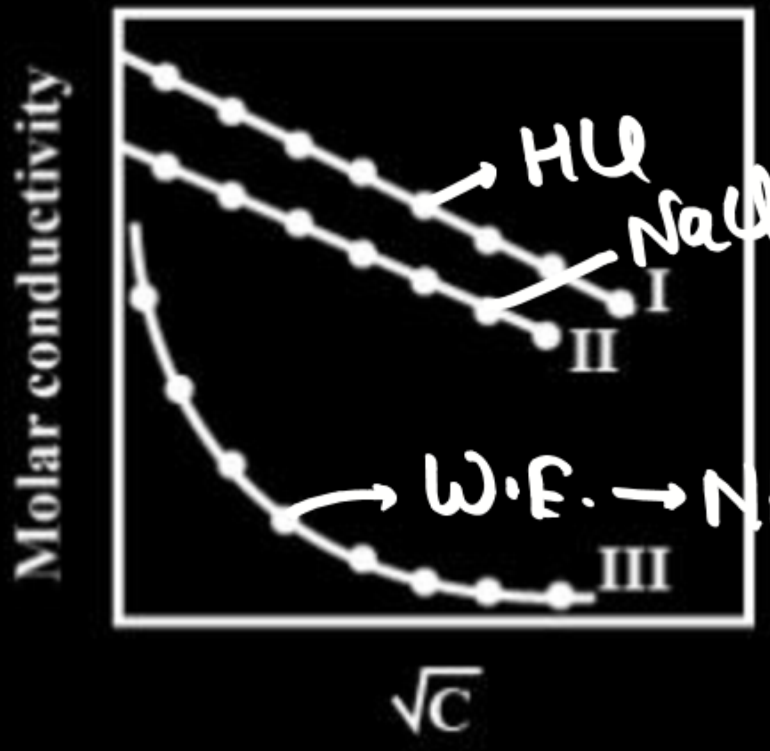
b) HCl

c) CH_3COOH

d) KN03

6. A graph was plotted between molar conductivity of various electrolytes (NaCl, HCl nad NH_4OH) and $\sqrt{C}$ (in mol L^{-1}). Correct set is:

(a) I(NaCl), II(HCl), III(NH_4OH)
(b) I(HCl), II(NaCl), III(NH_4OH)
(c) I(NH_4OH), II(NaCl), III(HCl)
(d) I(NH_4OH), II(HCl), III(NaCl)



→ At infinite dilution or Concentration of electrolyte → zero ($C \to 0$)

→ $\alpha \simeq 100$

→ distance = Very Very large → $F_A = 0$

→ Ions = feel = No Attraction or No Repulsion

→ Cond^c. of Ions at finite dilution = max. Value = Const and not depend upon parents molecule

$$\left[(\lambda_m^{\infty})_{CH_3COO^-}\right]_{CH_3COOH} \simeq \left[(\lambda_m^{\infty})_{CH_3COO^-}\right]_{CH_3COONa}$$

→ $(\lambda_m^{\infty})_{compound}$ = Sum of molar Cond^c of ions at infinite dilution

Suppose → $A_xB_y \rightleftharpoons xA^{+y} + yB^{-x}$

$$\left(\lambda_m^{\infty}\right)_{A_xB_y} = x \times \left(\lambda_m^{\infty}\right)_{A^{+y}} + y \times \left(\lambda_m^{\infty}\right)_{B^{-x}}$$

$$\left(\lambda_e^{\infty}\right)_{A_xB_y} = \left(\lambda_e^{\infty}\right)_{A^{+y}} + \left(\lambda_e^{\infty}\right)_{B^{-x}}$$

Ex → $Al_2(SO_4)_3$ → $\left(\lambda_m^{\infty}\right)_{Al_2(SO_4)_3} = 2 \times \left(\lambda_m^{\infty}\right)_{Al^{+3}} + 3 \times \left(\lambda_m^{\infty}\right)_{SO_4^{-2}}$

$$\left(\lambda_e^{\infty}\right)_{Al_2(SO_4)_3} = \left(\lambda_e^{\infty}\right)_{Al^{+3}} + \left(\lambda_e^{\infty}\right)_{SO_4^{-2}}$$

Q Molar conductance of CH_3COO^- ion in $0.1\ M\ CH_3COOH$ solution and $0.1\ M\ CH_3COONa$ solution at infinite dilution are x and y $S\ cm^{-2}\ mole^{-1}$ respectively. select correct option.

W.E.

S.E.

(A) $x = y$

(B) $x = y$

(C) $x < y$

(D) $x = 2y$

Q Molar conductance of Al^{+3} and SO_4^{-2} at infinite dilution 120 and 80 S cm^{-2} $mole^{-1}$ respectively, Calculate molar conductance of $Al_2(SO_4)_3$ at infinite dilution.

(A) 200

(B) 480

(C) 240

(D) 360

$$(\Lambda_m^\infty)_{Al_2(SO_4)_3} = 2\times(\Lambda_m^\infty)_{Al^{+3}} + 3\times(\Lambda_m^\infty)_{SO_4^{-2}}$$

$$= 2\times120 + 3\times80$$

$$= 240 + 240$$

$$= 480\ S\cdot cm^2\ mole^{-1}$$

Q equivalent conductance of Al^{+3} and SO_4^{-2} at infinite dilution 120 and 80 $S\,cm^{-2}\,eq^{-1}$ respectively, Calculate equivalent conductance of $Al_2(SO_4)_3$ at infinite dilution.

(A) 200

(B) 480

(C) 240

(D) 360

$$(\lambda_e^\infty)_{Al_2(SO_4)_3} = (\lambda_e^\infty)_{Al^{+3}} + (\lambda_e^\infty)_{SO_4^{-3}}$$

$$= 120 + 80 = 200\ S\,cm^2\,eq^{-1}$$

Q15. Limiting molar conductivity of NH_4OH (i.e., $\Lambda_{m(NH_4OH)}$) is equal to

(a) $\Lambda_{m(NH_4Cl)} + \Lambda_{m(NaCl)} - \Lambda_{m(NaOH)}$

(b) $\Lambda_{m(NaOH)} + \Lambda_{m(NaCl)} - \Lambda_{m(NH_4Cl)}$

(c) $\Lambda_{m(NH_4OH)} + \Lambda_{m(NH_4Cl)} - \Lambda_{m(HCl)}$

(d) $\Lambda_{m(NH_4Cl)} + \Lambda_{m(NaOH)} - \Lambda_{m(NaCl)}$

Q43. Equivalent conductance of NaCl, HCl and C_2H_5COONa at infinite dilution are 126.45, 426.16 and 91 Ω^{-1} cm^2, respectively. The equivalent conductance of C_2H_5COOH is

(a) 201.28 Ω^{-1} cm^2 (b) 390.71 Ω^{-1} cm^2

(c) 698.28 Ω^{-1} cm^2 (d) 540.48 Ω^{-1} cm^2

NaCl = 126.45

HCl = 426.16

C_2H_5COONa = 91

$(\lambda_e^{\infty})_{C_2H_5COOH} = ?$

$C_2H_5COOH \rightarrow C_2H_5COO^- + H^+$

$(91 + 426.16) - 126.45$

$= 91 + 300$

Q39. The equivalent conductances of Ba^{2+} and Cl^- are 127 and $76 \Omega^{-1}$ cm^{-1} eq^{-1} respectively at infinite dilution. The equivalent conductance of $BaCl_2$ at infinite dilution will be

(a) 139.52

(b) 203

(c) 279

(d) 101.5

$$(\lambda_e^\infty)_{BaCl_2} = (\lambda_e^\infty)_{Ba^{+2}} + (\lambda_e^\infty)_{Cl^-}$$

$$= 127 + 76$$

$$= 203$$

CSD

- $\lambda_m = \eta \times \lambda_e$
- η-factor of Ions = Charge of Ions
- η-factor of salt = total +ve or -ve charge
- Cond^c, λ_m & λ_e → increases on dilution or decrease in Con. of electrolyte

Reason 1) No. of ions = increases $\left(\alpha = \sqrt{\frac{K_a}{C\downarrow}}\right)$

2) distance b/w ions = increases

- Conductivity (K) decreases on dilution or decrease in Con.

Reason = No. of ions per cm^3
Volume decrease

- **Strong electrolyte**

$$\lambda_m^v = \lambda_m^\infty - B\sqrt{C}$$

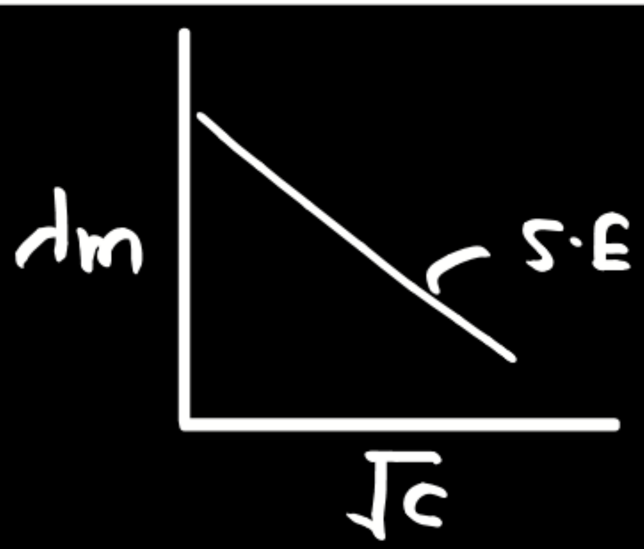
Debye, Onsagar & Huckel Eq.

λ_m^v & λ_m^∞ = molar Cond^c at finite dilution & infinite dilution

$\sqrt{C}$ = Con. of electrolyte

B = Const (depend upon nature of solute and solvent)

→ **CSD**



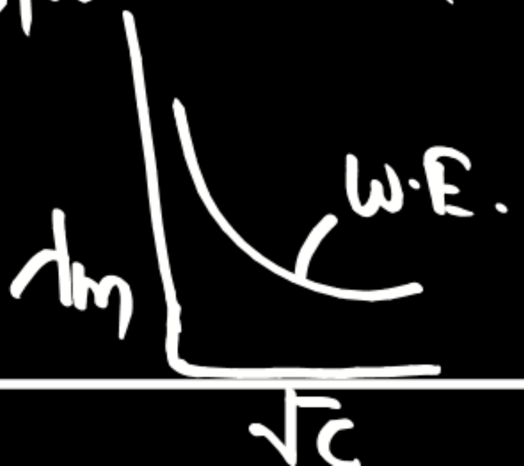
$$\lambda_m = \lambda_m^\infty - B\sqrt{c}$$
$$y = c - mx$$

Weak electrolyte

W·E. Cond^c increases on dilution or decrease Con. of electrolyte

1) Merge Reason → No. of ions increases

2) distance b/w ions = increases



Kohrausch's law

→ At infinite dilution

→ Cond^c of ions at infinite dilution = max value, Const and not depend upon its parents molecules

→ $(\lambda_m^\infty)_{molecule}$ = sum of Cond^c of all ions

Suppose → $A_xB_y \rightleftharpoons xA^{+y} + yB^{-x}$

$$(\lambda_m^\infty)_{A_xB_y} = x(\lambda_m^\infty)_{A^{+y}} + y \times (\lambda_m^\infty)_{B^{-x}}$$

$\underline{C_{SD}}$

$$(\lambda_e^\infty)_{A_x B_y} = (\lambda_e^\infty)_{A^{+y}} + (\lambda_e^\infty)_{B^{-x}}$$

Solubility of sparingly soluble salt

4. The specific conductance of a saturated solution of silver bromide is κ Scm^{-1}. The limiting ionic conductivity of Ag^+ and Br^- ions are x and y, respectively. The solubility of silver bromide in gL^{-1} is: (molar mass of AgBr = 188)

(a) $\dfrac{\kappa \times 1000}{x - y}$

(b) $\dfrac{\kappa}{x+y} \times 188$

(c) $\dfrac{\kappa \times 1000 \times 188}{x + y}$

(d) $\dfrac{x+y}{k} \times \dfrac{1000}{188}$

Degree of dissociation in term of conductance

Q13. At 25°C molar conductance of 0.1 molar aqueous solution of ammonium hydroxide is $9.54 \Omega^{-1} cm^2 mol^{-1}$ and at infinite dilution its molar conductance is $238 \Omega^{-1} cm^2 mol^{-1}$. The degree of ionisation of ammonium hydroxide at the same concentration and temperature is

(a) 2.080% (b) 20.800%

(c) 4.008% (d) 40.800%

55. Λ_m^o for NaCl, HCl and NaA are 126.4, 425.9 and 100.5 S cm^2 mol^{-1}, respectively. If the conductivity of 0.001 M HA is 5×10^{-5} S cm^{-1}. degree of dissociation of HA is

(A) 0.25

(B) 0.50

(C) 0.75

(D) 0.125

Thank you!

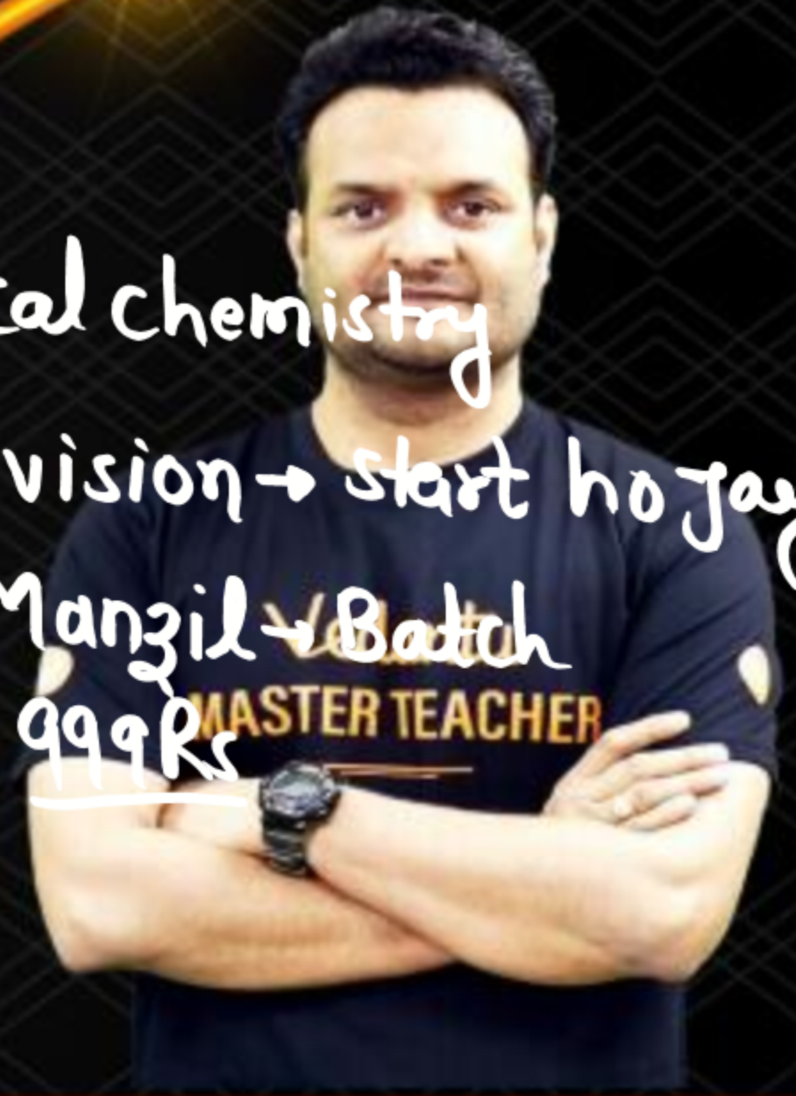
MANTHAN NEET 2025

Qsd = ?

CHEMISTRY

ELECTROCHEMISTRY

→ Physical chemistry
Revision → start ho jayega
→ Manzil → Batch
999Rs



Lecture-03

Sarvesh Sir

Today's Goal -

Kohlrausch's law

Cell

Galvanic cell

Electrode potential



Qsd-1 An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to

[CBSE AIPMT 2010]

(a) increase in ionic mobility of ions

(b) 100% ionisation of electrolyte at normal dilution

(c) increase in both, i.e., number of ions and ionic mobility of ions

(d) increase in number of ions

Q. Equivalent conductance of NaCl, HCl and C_2H_5COONa at infinite dilution are 126.45, 426.16 and 91 Ω^{-1} cm^2, respectively. The equivalent conductance of C_2H_5COOH is

[CBSE AIPMT 1997]

(a) 201.28 Ω^{-1} cm^2

(b) 390.71 Ω^{-1} cm^2

(c) 698.28 Ω^{-1} cm^2

(d) 540.48 Ω^{-1} cm^2

$= (91 + 426.16) - 126.45$

$= 390.71$

Solubility of sparingly soluble salt

sparingly soluble salt = Very Very less soluble in solution

salt or Compound <<<< 1

$\lambda_m = \frac{K \times 10^3}{M} \Rightarrow \boxed{\lambda_m = \frac{K \times 10^3}{S}} \Rightarrow S\left(\frac{g}{litre}\right) = S\left(\frac{mole}{litre}\right) \times M$

where = M = molarity of sol^n = No. of mole of solute dissolve in 1 litre of sol^n

M = S (mole/litre)

S → Solubility of molecule

4. The specific conductance of a saturated solution of silver bromide is κ Scm^{-1}. The limiting ionic conductivity of Ag^+ and Br^- ions are x and y, respectively. The solubility of silver bromide in gL^{-1} is: (molar mass of AgBr = 188)

(a) $\frac{\kappa \times 1000}{x - y}$

(b) $\frac{\kappa}{x+y} \times 188$

(c) $\frac{\kappa \times 1000 \times 188}{x + y}$

(d) $\frac{x+y}{k} \times \frac{1000}{188}$

$(\lambda_m)_{AgBr} = (\lambda_m)_{Ag^+} + (\lambda_m)_{Br^-} = x+y$

$\lambda_m = \frac{\kappa \times 10^3}{s}$

$s = \frac{\kappa \times 10^3}{\lambda_m}$

$s = \frac{\kappa \times 10^3}{(x+y)}$ mole/litre

$s = \left(\frac{\kappa \times 10^3}{x+y}\right) \times 188$

Degree of dissociation in term of conductance

$$\alpha = \frac{\text{Molar Cond}^c \text{ at finite dilution}}{\text{Molar Cond}^c \text{ at infinite dilution}} \times 100$$

$$\alpha = \frac{\lambda_m^v}{\lambda_m^\infty} \times 10^2 = \frac{\lambda_e^v}{\lambda_e^\infty} \times 10^2 = \frac{\text{Cond}^c \text{ at finite dilution}}{\text{Cond}^c \text{ at infinite dilution}} \times 10^2$$

α ↓ degree of dissociation

$$HA \rightleftharpoons H^+ + A^-$$

HA	H^+	A^-
C	0	0
$C(1-\alpha)$	$C\alpha$	$C\alpha$

$$K_a = \frac{C\alpha \times C\alpha}{C(1-\alpha)} = \frac{C\alpha^2}{1-\alpha}$$

$$\boxed{K_a = \frac{C\alpha^2}{1-\alpha}}$$

Q13. At 25ºC molar conductance of 0.1 molar aqueous solution of ammonium hydroxide is $9.54 \Omega^{-1}\ cm^2\ mol^{-1}$ and at infinite dilution its molar conductance is $238 \Omega^{-1}\ cm^2\ mol^{-1}$. The degree of ionisation of ammonium hydroxide at the same concentration and temperature is

[CBSE AIPMT 2013]

(a) 2.080%

(b) 20.800%

(c) 4.008%

(d) 40.800%

$$\alpha = \frac{\lambda_m^v}{\lambda_m^\infty} \times 100 = \frac{9.54}{238} \times 100 = \frac{954}{238} = 4\% \text{ approx}$$

55. Λ_m^o for NaCl, HCl and NaA are 126.4, 425.9 and 100.5 S cm^2 mol^{-1}, respectively. If the conductivity of 0.001 M HA is 5×10^{-5} S cm^{-1}. degree of dissociation of HA is

$(425.9 + 100.5) - 126.4 = 400$

(2019 Main, 12 Jan II)

(A) 0.25

(B) 0.50

(C) 0.75

(D) 0.125

$\lambda_m = \frac{K \times 10^3}{M}$

$= \frac{5 \times 10^{-5} \times 10^3}{10^{-3}}$

$(\lambda_m)_{HA} = 50$

$\alpha = \frac{(\lambda_m^v)_{HA}}{(\lambda_m^\infty)_{HA}} \times 10^2 = \frac{50}{400} \times 100$

$12.5\% = 0.125$

Electrochemical process

those process are called electrochemical process in which Chemical energy Convert into electrical energy and Viceversa

$$C.E. \rightleftharpoons E.E$$

Cell ⇒ It is a device, in which electro-chemical process take place

Cell

Electro-chemical cell

→ Galvanic cell

→ Chemical energy ⟶ electrical energy

→ Spontaneous cell

Electrolytic cell

→ electrical energy → chemical energy

→ nonspontaneous (work in presen-ce of external agent)

Galvanic cell

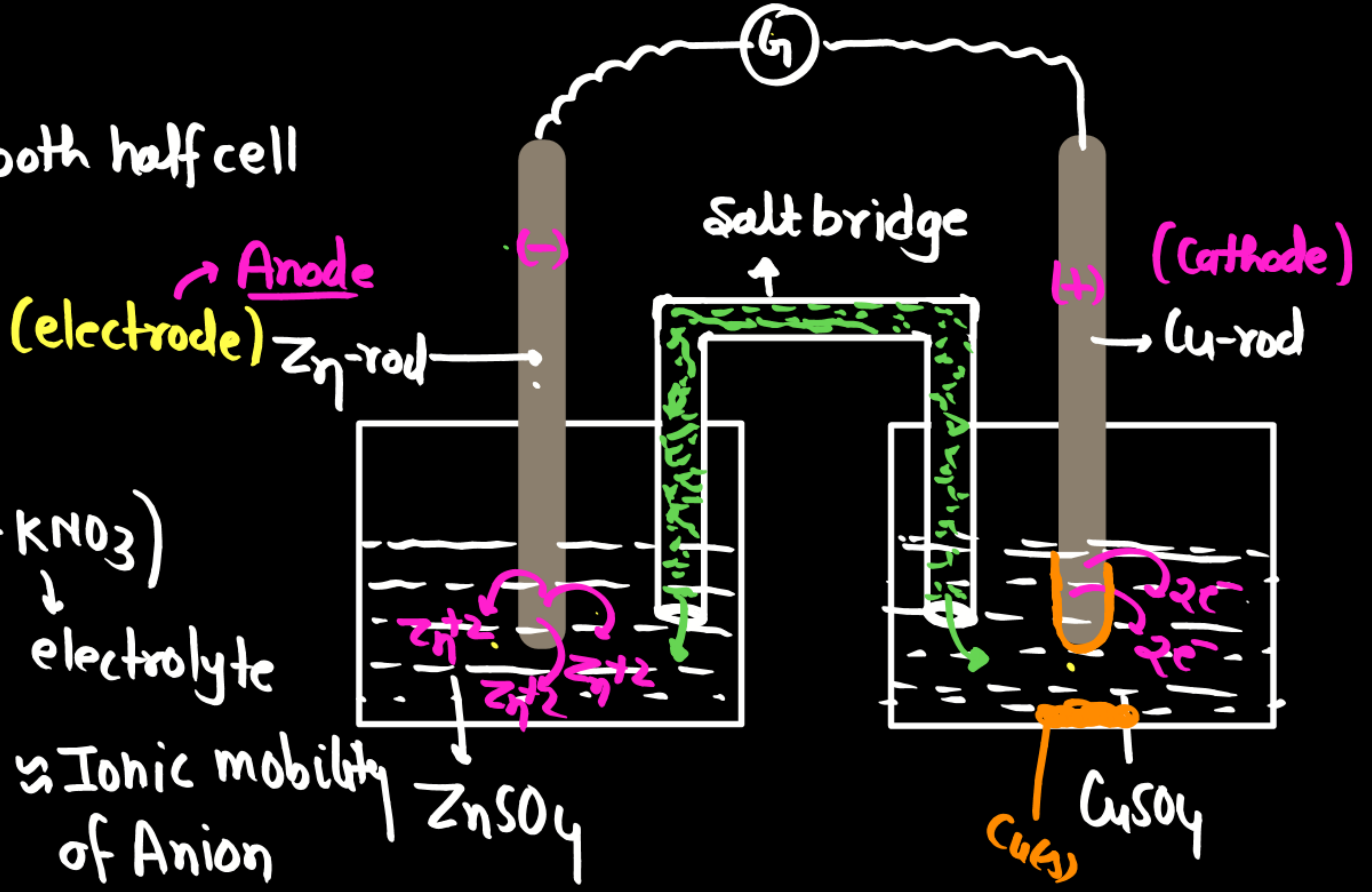
Daniel cell

Salt bridge → neutralise both half cell

→ ∩ → tube = Connect two half cell (electrode)

→ Agar-Agar jelly + (NH_4Cl + KNO_3) = semi solid paste
(KNO_3 ↓ electrolyte)

→ Ionic mobility of Cation ≈ Ionic mobility of Anion



Electrode (half cell)

It is a device, connect inner circuit (electrolyte solution) and outer circuit |

- → Conductor
- → Rod, wire, layer
- → 2 type electrode

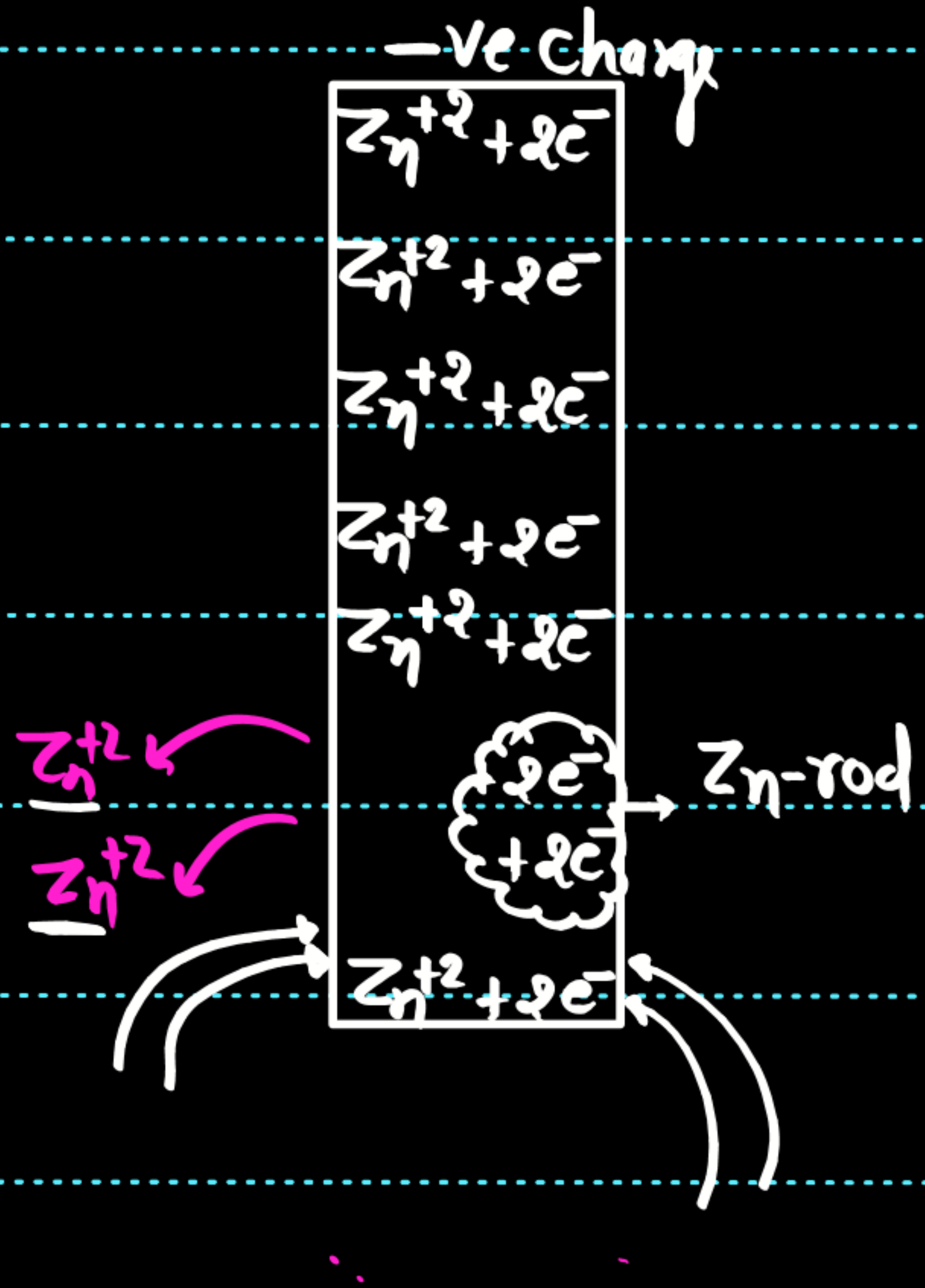
electrode →

Normal electrode (or electrode)

- → participate in cell rxn
- → self → oxidation or Reduction
- → e^- → transfer

Inert electrode

- → e^- only transfer, Pt-electrode, graphite rod
- → No oxd^n or Red^n.



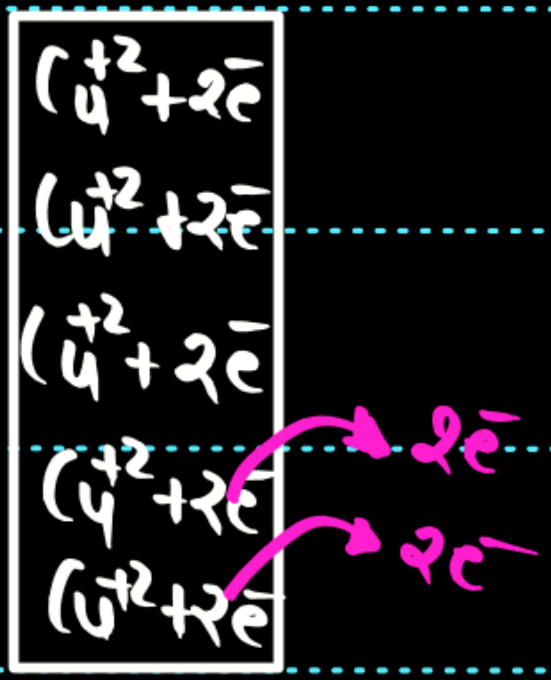
1) No rxn → Cell not work

2) Cation (Zn^{+2}) release

3) electron ($2e^-$) release

$$\overset{0}{Zn}(s) \longrightarrow \overset{+2}{Zn^{+2}}(aq) + 2e^-$$

Oxd^n = Anode → -ve rod



$$\overset{+2}{Cu^{+2}}(aq) + 2e^- \longrightarrow \overset{0}{Cu}(s)$$

Red^n → Cathode

Type of Electrode (half cell)

→ Metal-metal ion half

→ Gas-Gas ion half

→ Reduction-oxidation one half

Metal –metal ion electrode (half cell)

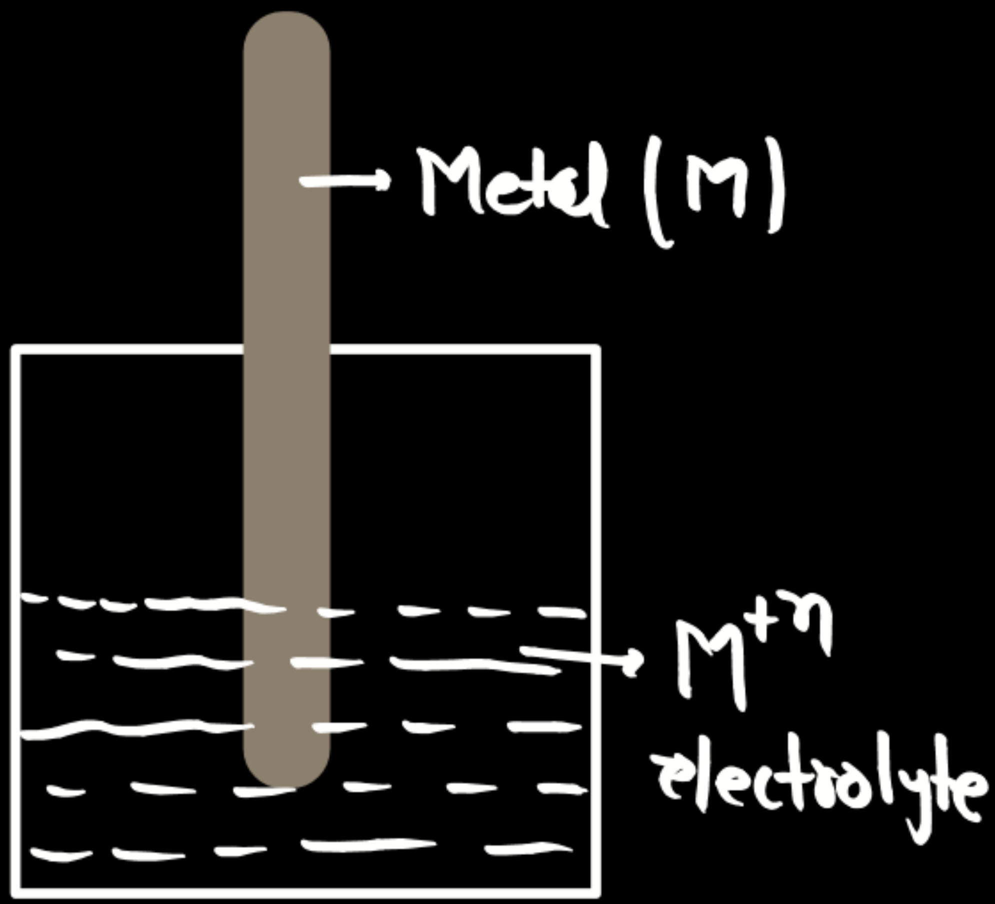
Combination ⇒ Metal + Metal ion Ka electrolyte

Ex → $Zn(s) \mid Zn^{+2}(aq)$

$Cu(s) \mid Cu^{+2}(aq)$ — oxdn or Redn

$Ni(s) \mid Ni^{+2}(aq)$

$Fe(s) \mid Fe^{+3}(aq)$





GAS -GAS ION ELECTRODE (HALF CELL)

Combination = Gas + Gas ke ion ka electrolyte + Pt-wire

→ $H_2(g) \mid H^+(aq)$

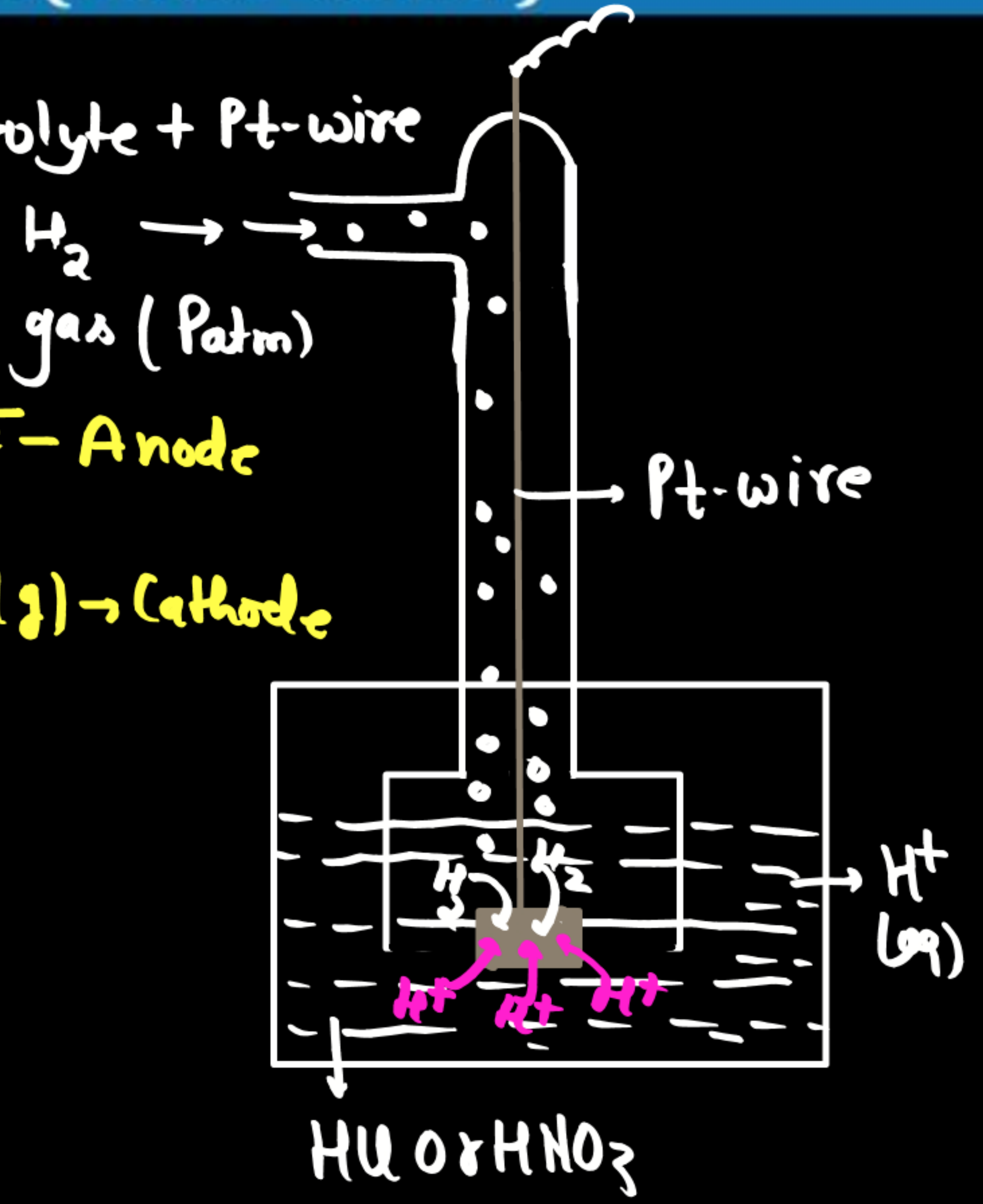
→ $Cl_2(g) \mid Cl^-(aq)$

→ $Br_2(g) \mid Br^-(aq)$

→ $O_2(g) \mid OH^-(aq)$

$\overset{0}{H_2} \longrightarrow \overset{+1}{H^+}(aq) + 2e^-$ – Anode

$2\overset{+1}{H^+}(aq) + 2e^- \longrightarrow \uparrow \overset{0}{H_2}(g) \rightarrow$ Cathode



Thank you!

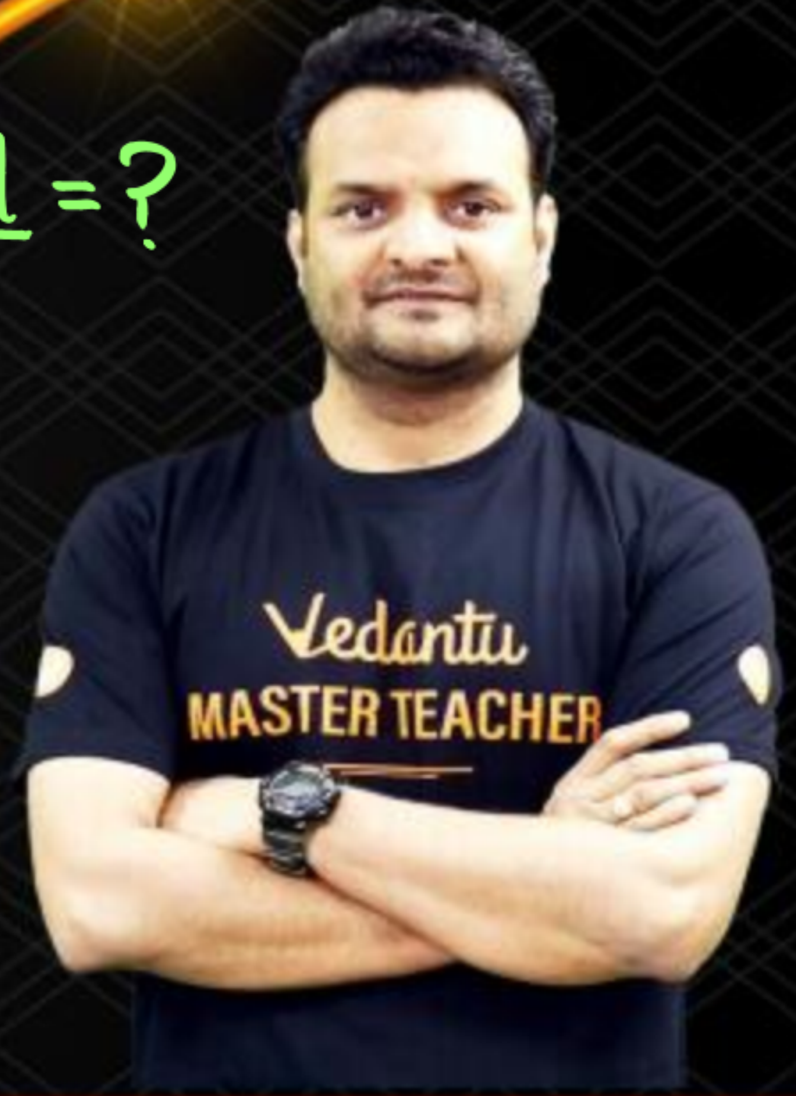
MANTHAN NEET 2025

CHEMISTRY

ELECTROCHEMISTRY

Lecture-04

$\phi_{sd} = ?$



Sarvesh Sir

Today's Goal -

Electrode potential
Gibbs free energy
Nernst equation
Concentration cell



Qsd-1 molar cond^c of CH_3COOH at 0.1M Con and infinite dilution is 40 and 200 $S cm^2 mole^{-1}$ respectively. Calculate degree of dissociation of CH_3COOH

a) 12.5%

b) 25%

c) 50%

d) 20% ✓

$$\alpha = \frac{\lambda_m^v}{\lambda_m^\infty} \times 100$$

$$= \frac{40}{200} \times 100 = 20\%$$

Q sd-2 Select metal-metal ion half cell

✗ a) $H_2 | H^+(aq)$

✓ b) $Fe | Fe^{+2}(aq)$

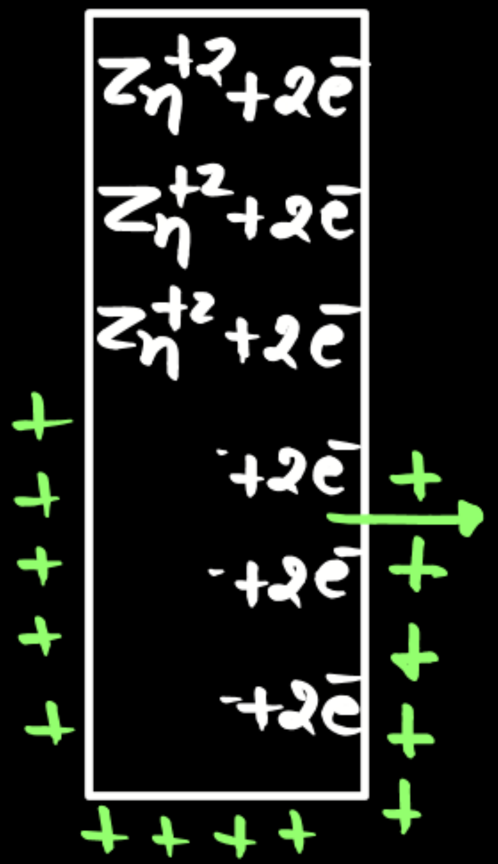
✗ c) $Cl_2 | Cl^-(aq)$

✗ d) $O_2 | OH^-(aq)$

Metal + Metal ion (aq)

$\frac{?}{2}$

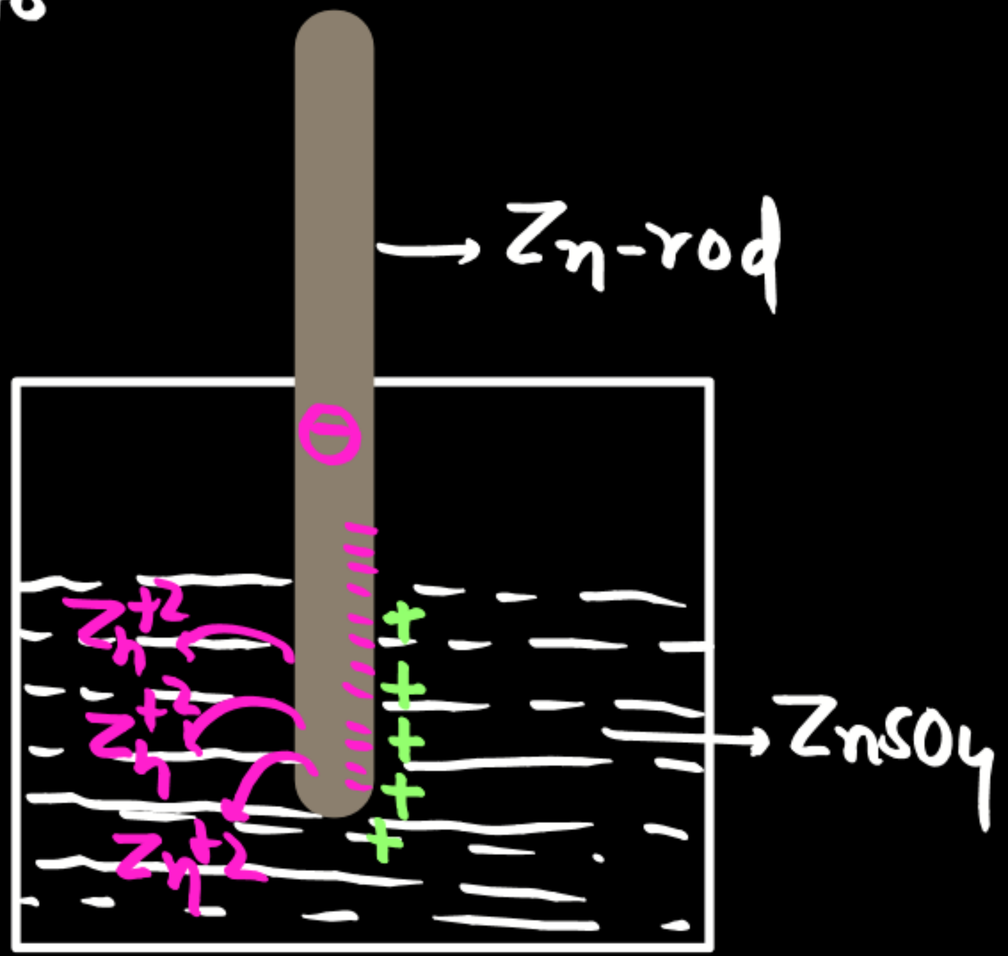
Electrode potential



potential difference occurs between electrode and electrolyte solution due to double layer of charge

This electrode potential difference is called electrode potential

Represent → E



Standard electrode Potential (E°)

Concentration = 1M at 25°C temp.

Electrode potential measure at 1M electrolyte solution is Known as standard electrode potential

Represent → E°

Electrode Potential →
- → Oxidation electrode Potential
  → E_{OP} (Oxidation)
- → Reduction Electrode Potential
  → E_{RP} (Reduction)

CSD Electrode Potential = Potential difference arise b/w electrode and electrolyte solution

Standard electrode Pot (E^0) = Electrode Pot measure at 1M Con. and 25°C or 298K temp

→ 1) Electrode Potential ⇒ State function

$Zn(s) \longrightarrow Zn^{+2}(aq)$, E^0_{op}

$Zn^{+2}(aq) \longrightarrow Zn(s)$, E^0_{RP}

$$\boxed{E^0_{op} = -E^0_{RP}}$$

2) Electrode Potential = Intensive properties

$Zn(s) \longrightarrow Zn^{+2}(aq)$, $E^0_{op} = +x_1 V$

$2Zn(s) \longrightarrow 2Zn^{+2}(aq)$, $E^0_{op} = +x_1 V$

3) Electrode Potential (E) → depend upon Concentration of electrolyte

Standard Electrode Potential (E^0) → does not depend upon Con. of electrolyte

CSD 4) E^0_{RP} = highest ⇒ max. tendency to gain e^- or max tendency to reduce themself.

→ Reducing agent $\propto \frac{1}{E^0_{RP}}$

$M^{+n}(aq) \mid M(s) \rightarrow E^0_{RP}$

M ↓ Reducing agent

→ Oxidising agent $\propto E^0_{RP}$

$M^{+n}(aq) \mid M(s)$

M^{+n} ↓ Oxidising agent

5) Cell = half cell-1 + half cell-2

E^0_{RP} = highest → Cathode → dono half cell

Ke Compare me

6)

Q

$\overset{+2}{Z_n^{+2}}(aq) + 2e^- \longrightarrow \overset{0}{Z_n}(s), E^0_{RP} = -0.76\ V$

Calculate standard oxidation potential of $\overset{0}{Z_n}(s)\ |\ \overset{+2}{Z_n^{+2}}(aq)$ half cell.

(A) $-0.76\ V$

(B) $+0.76\ V$ ✓

(C) $+2 \times 0.76\ V$

(D) None of these

$E^0_{RP} = -0.76V$

$E^0_{op} = +0.76V$

Q → $Ag^{+}(aq) \rightleftharpoons Ag(s)$, $E^{0}_{RP} = x_1 V$, $K_{eq} = y$, $\Delta H = z$

$2Ag^{+}(aq) \rightleftharpoons 2Ag(s)$

$E^{0}_{RP} = ?$

a) $x_1 V$ (✓)

b) $x_1^{2} V$

c) $2x_1 V$

d) NONE

$K_{eq} = ?$

a) y

b) y^{2} (✓)

c) $2y$

d) NONE

$\Delta H = ?$

a) z

b) z^{2}

c) $2z$ (✓)

d) NONE

Q

Standard electrode potential of 0.1 M Z_n^{+2} (aq) | Zn(s) half cell is x_1 ev. If concentration of half cell change 10^{-3}M z_n^{+2} (aq) | Zn(s) then standard electrode potential is x_2 eV. select correct relation between x_1 and x_2.

(A) $x_1 > x_2$

(B) $x_1 < x_2$

(C) $x_1 = x_2$

(D) $x_1 = 100\, x_2$

Q

E_{RP}

Electrode potential of 0.1 M Z_n^{+2} (aq) | Zn(s) half cell is x_1 ev. If concentration of half cell change 10^{-3}M z_n^{+2}(aq) | Zn(s) then electrode potential is x_2 eV. select correct relation between x_1 and x_2.

(A) $x_1 = x_2$ $x_1 \neq x_2$

(B) $x_1 \neq x_2$

17. The standard reduction potential values of three metallic cations, X, Y, Z are 0.52, - 3.03 and - 1.18 V respectively. The order of reducing power of the corresponding metals is

(1998, 2M)

(A) $Y > Z > X$

(B) $X > Y > Z$

(C) $Z > Y > X$

(D) $Z > X > Y$

5. **Consider the following reduction processes:**

$Zn^{2+} + 2e^- \rightarrow Zn(s);\ E^\circ = -0.76\ V$

$Ca^{2+} + 2e^- \rightarrow Ca(s);\ E^\circ = -2.87\ V$

$Mg^{2+} + 2e^- \rightarrow Mg(s);\ E^\circ = -2.36\ V$

$Ni^{2+} + 2e^- \rightarrow Ni(s);\ E^\circ = -0.25\ V$

The reducing power of the metals increases in the order

(2019 Main, 10 Jan I)

(A) $Zn < Mg < Ni < Ca$

(B) $Ni < Zn < Mg < Ca$

(C) $Ca < Zn < Mg < Ni$

(D) $Ca < Mg < Zn < Ni$

24. The standard reduction potentials at 298K for the following half cells are given:

$Zn^{2+}(aq) + 2e^- \leftrightharpoons Zn(s)$; $E° = -0.762$ V

$Cr^{3+}(aq) + 3e^- \leftrightharpoons Cr(s)$; $E° = -0.740$ V

$2H^+(aq) + 2e^- \leftrightharpoons H_2(g)$; $E° = 0.000$ V

$Fe^{3+}(aq) + e^- \leftrightharpoons Fe^{2+}(aq)$; $E° = 0.770$ V

Which is the strongest reducing agent?

(1981 1M)

(A) $Zn(s)$ (B) $Cr(s)$

(C) $H_2(g)$ (D) $Fe^{2+}(aq)$

Q → 1) $Zn^{+2} | Zn$ → $E^0_{RP} = -0.76V$ → Anode

2) $Cu^{+2} | Cu$ → $E^0_{RP} = +0.34V$ ✓✓ → Cathode

Which one behaves as a cathode in a spontaneous cell

a) 1

b) 2

c) 1 or 2

d) NONE

Q

(1) $Cu^{+2}(aq) \mid Cu(s), E^0_{RP} = +0.34\ V$ → Anode

(2) $Ag^{+}(aq) \mid Ag(s), E^0_{RP} = +0.79\ V$ → Cathode

If we form a Galvanic cell with combination of above two half cell, which one half cell behaves as a cathode

(A) 1

(B) 2 ✓

(C) both

(D) None

Q

(1) $Z_n^{+2}(aq) \mid Z_n(s), E^0_{RP} = -0.76\ V$

(2) $Cu^{+2}(aq) \mid Cu(s), E^0_{RP} = +0.34\ V$

(3) $Ag^{+1}(aq) \mid Ag(s), E^0_{RP} = +0.79\ V$

select correct combination of cell.

(A) 1– Cathode, 2 → Anode

(B) 1 – Anode, 3 → Cathode

(C) 3 –Anode, 2–Cathode

(D) all combination is possible

Cell potential

Cell ⇒ Reduction half cell + oxidation half cell

Cell Reaction = Anode half cell + Cathode half cell

→ Redox reaction

Ex → $Zn^{+2} | Zn \Rightarrow E^{0}_{R.P} = -0.76V$

$Cu^{+2} | Cu \Rightarrow E^{0}_{RP} = +0.34V$

$Cu^{+2}(aq) + \cancel{2e^-} \longrightarrow Cu(s)$ → Cathode

$Zn(s) \longrightarrow Zn^{+2}(aq) + \cancel{2e^-}$ → Anode

$Zn(s) + Cu^{+2}(aq) \longrightarrow Zn^{+2}(aq) + Cu(s)$

Q → $Ag^{+}|Ag \rightarrow E^{0}_{RP} = +0.80\,V$ → (C)

$Cu^{+2}|Cu \rightarrow E^{0}_{RP} = +0.34\,V$ → (A)

the cell rxn is

a) $2Ag^{+} + Cu \longrightarrow 2Ag + Cu^{+2}$ ✓

b) $2Ag + Cu^{+2} \longrightarrow 2Ag^{+} + Cu$

c) $2Ag^{+}(aq) \longrightarrow 2Ag(s)$

d) $Cu^{+2}(aq) \longrightarrow Cu(s)$

$(Ag^{+}(aq) + \cancel{e^{-}} \longrightarrow Ag(s) \rightarrow \text{(C)}) \times 2$

$Cu(s) \longrightarrow Cu^{+2}(aq) + \cancel{2e^{-}} \rightarrow \text{(A)}$

$2Ag^{+} + Cu \longrightarrow 2Ag + Cu^{+2}$ → cell rxn

Q → $H^+(aq) | H_2(g), Pt$ → $E^0_{RP} = 0.00V$ — (A)

$Cu^{+2} | Cu$ → $E^0_{RP} = +0.34V$ — (C)

Select cell rxn

a) $Cu^{+2} + H_2 \longrightarrow Cu + 2H^+$ ✓

b) $Cu + 2H^+ \longrightarrow H_2 + Cu^{+2}$

c) NONE

d) Can not form cell

$Cu^{+2}(aq) + 2e^- \rightarrow Cu(s)$ → (C)

$H_2(g) \longrightarrow 2H^+(aq) + 2e^-$ — (A)

$Cu^{+2}(aq) + H_2(g) \longrightarrow Cu(s) + 2H^+(g)$

Representation of cell

Cell = Anode Rxn || Cathode rxn

Anode Rxn ↓ Oxidation; || ↓ Salt bridge; Cathode rxn ↓ Reduction

$Zn(s) + Cu^{+2}(aq) \longrightarrow Zn^{+2}(aq) + Cu(s)$

Cell = $Zn(s) | Zn^{+2}(aq) || Cu^{+2}(aq) | Cu(s)$

$\overset{0}{H_2}(g) + 2Ag^{+}(aq) \longrightarrow 2Ag(s) + 2\overset{+1}{H^{+}}(aq)$

Cell = $Pt, H_2(g) | H^{+}(aq) || Ag^{+}(aq) | Ag(s)$

Ex → $Ni(s) + 2Ag^{+}(aq) \longrightarrow Ni^{+2}(aq) + 2Ag(s)$

Select Correct representation

Cell ⇒ Anode || Cathode

a) $\overset{0}{Ni}(s) \mid \overset{+2}{Ni^{+2}}(aq) \parallel Ag^{+}(aq) \mid Ag(s)$ ✓

b) ✗ $\overset{+1}{Ag^{+}} \mid \overset{0}{Ag}(s) \parallel Ni(s) \mid Ni^{+2}(aq)$ ✗

c) both Correct

d) NONE

Q → $2H^{+}(aq) + \overset{0}{Zn}(s) \longrightarrow H_2(g) + \overset{+2}{Zn^{+2}}(aq)$

Anode

Correct representation

a) $H^{+} | H_2(g), Pt \,||\, Zn^{+2} | Zn$ ✗

b) $Zn^{+2}(aq) | Zn(s) \,||\, H^{+}(aq) | H_2(g), Pt$ ✗

c) both

d) NONE ✓ $Zn(s) | Zn^{+2}(aq) \,||\, H^{+}(aq) | H_2(g), Pt$

Thank you!

MANTHAN NEET 2025

SANKALP NEET VEDANTU

CHEMISTRY

ELECTROCHEMISTRY

Lecture-05

Qsd →



Chhath PUJA
5, 6, 7, 8 NOV
all offer

Sarvesh Sir

Today's Goal -

Electrode potential
Gibbs free energy
Nernst equation
Concentration cell

Qsd-1 a) $H^+ | H_2(g)$, $E^0_{RP} = 0.00V$

b) $Cu^{+2} | Cu(s)$, $E^0_{RP} = +0.34V$

which half cell behaves as a cathode

i) a

ii) b

iii) both

iv) Can not say

E^0_{RP} = highest → Cathode

Qsd-2

$$Cu^{+2}(aq) + 2e^- \longrightarrow Cu(s), \quad E^0_{RP} = +0.34V$$

Calculate E^0_{RP} of $2Cu^{+2} + 2e^- \rightarrow 2Cu$

a) $E^0_{RP} = 0.34V$ ✓ E^0 = Intensive propʳ

b) $E^0_{RP} = 2 \times 0.34V$

c) $E^0_{RP} = (0.34)^2 V$

d) $E^0_{RP} = \frac{0.34}{2} V$

$$\frac{?}{2}$$

Cell potential

Cell = Anode + Cathode

$$E^0_{cell} = (E^0_{RP})_C - (E^0_{RP})_A$$

$i \neq 0 \rightarrow$ $$E_{cell} = (E_{RP})_C - (E_{RP})_A$$

emf of cell

$i = 0 \rightarrow E_{cell}$ = emf of cell

emf = electromotive force

CSD E_{cell} = Potential difference of cell → $(E_{cell})_{max} = (E_{RP})_C - (E_{RP})_A$

↓ highest ↓ lowest

$E^\circ_{cell} = (E^\circ_{RP})_C - (E^\circ_{RP})_A$

$E_{cell} = (E_{RP})_C - (E_{RP})_A$

Spontaneous of cell

Emf of cell → $i = 0$ → E_{cell} = emf of cell → $\Delta G = -nFE_{cell}$

→ E°_{cell} doesnot depend upon Concentration of electrolyte. (Reason → E°_{cell} → measure = 1M)

→ E_{cell} depend upon Concentration of electrolyte

- E_{cell} = +ve → ΔG = −ve → spontaneous
- E_{cell} = −ve, ΔG = +ve → nonspontaneous
- $E_{cell} = 0$ → $\Delta G = 0$ → at Equilibrium

CSD → yadi → 2 half cell diye ho

Aur cell Rxn Ko Potential puch raha hai

$E_{cell} = (E_{RP})_C - (E_{RP})_A$

→ yadi → 2-half cell de Kr

Aur 3rd half cell Ka Potential puchh raha hai

→ ΔG method se solve Krna hai

Reason – E ⇒ Intensive propr → Add → X, Subs → X

→ ΔG = Extensive propr → Add ✓

Subs ✓ Kr sakte hai

73. The standard reduction potentials of Cu^{2+}/Cu and Cu^{2+}/Cu^{+} and 0.337 V and 0.153 V respectively. The standard electrode potential of Cu^{+}/Cu half-cell is

(1997, 1M)

(A) 0.184 V
(B) 0.827 V
(C) 0.521 V
(D) 0.490 V

$Cu^{+2} \longrightarrow Cu \rightarrow 0.337$

$Cu^{+2} \longrightarrow Cu^{+1} \rightarrow 0.153$

$Cu^{+1} \longrightarrow Cu, \ E^{\circ}_{RP} = ?$

$Cu^{+2} \longrightarrow Cu \rightarrow \Delta G = -2 \times F \times 0.337$ — ①

$Cu^{+2} \longrightarrow Cu^{+1} \rightarrow \Delta G = -1 \times F \times 0.153$

$Cu^{+1} \longrightarrow Cu^{+2} \rightarrow \Delta G = +1 \times F \times 0.153$ — ②

① + ② $Cu^{+1} \longrightarrow Cu, \ \Delta G = -2 \times F \times 0.337 + 1 \times F \times 0.153$

$-1 \times F \times E = -2 \times F \times 0.337 + 1 \times F \times 0.153$

$-E = -.674 + 0.153$

$-E = -.521$

$E = +0.521V$

Q18. Standard electrode potential for Sn^{4+}/Sn^{2+} couple is +0.15V and that for the Cr^{3+}/Cr couple is –0.74. These two couples in their standard state are connected to make a cell. The cell potential will be

[CBSE AIPMT 2011]

(a) +0.89V (b) +0.18V
(c) +1.83V (d) +1.199V

$E^0_{cell} = (E^0_{RP})_C - (E^0_{RP})_A$

$= 0.15 - (-0.74)$

$= 0.15 + 0.74$

$+0.89V$

Q29. $E^{\circ}_{Fe^{2+}/Fe} = -0.441V$ and $E^{\circ}_{Fe^{3+}/Fe^{+2}} = 0.771V$ the standard emf of the reaction $Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}$ will be

[CBSE AIPMT 2006]

(a) 0.111 V (b) 0.330 V

(c) 1.653 V (d) 1.212 V

Red^n

$$Fe + 2Fe^{+3} \longrightarrow Fe^{+2} + 2Fe^{+2}$$

Oxd^n

$$E^{0}_{cell} = (E^{0}_{RP})_{C} - (E^{0}_{RP})_{A}$$

$$= 0.771 - (-0.441)$$

$$= +0\ 1.212$$

The standard reduction potentials of Fe^{2+}/Fe and Fe^{3+}/Fe^{+2} and 0.337 V and 0.153 V respectively. The standard electrode potential of Fe^{+3}/Fe half-cell is

$E^0_{RP} = ?$

(A) 0.184 V
(B) 0.827 V
(C) 0.276 V
(D) none of these

$Fe^{+3} \longrightarrow Fe$

① $Fe^{+2} \longrightarrow Fe$, $\Delta G = -2 \times F \times 0.337$

② $Fe^{+3} \longrightarrow Fe^{+2}$, $\Delta G = -1 \times F \times 0.153$

① + ② $Fe^{+3} \longrightarrow Fe$, $\Delta G = -2F \times 0.337 - 1 \times F \times 0.153$

$-3 \times F \times E^0_{RP} = -F \times .674 - F \times 0.153$

$3E^0_{RP} = 0.827$, $E^0_{RP} = +0.275$

18. The standard reduction potentials E°, for the half reactions are as

$Zn = Zn^{2+} + 2e^-$, $E^\circ_{op} = +0.76$ V → $E^\circ_{RP} = -0.76$ V — (A)

$Fe = Fe^{2+} + 2e^-$, $E^\circ_{op} = 0.41$ V → $E^\circ_{RP} = -0.41$ V → (C)

The emf for the cell reaction,

$Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ is

(1989, 1M)

(A) −0.35 V (B) + 0.35 V

(C) + 1.17 V (D) − 1.17 V

$E^\circ_{cell} = (E^\circ_{RP})_C - (E^\circ_{RP})_A$

$-0.41 - (-0.76)$

$-0.41 + 0.76$

$= +0.35$ V

Q14. A button cell used in watches functions as following

[NEET 2013]

$$Zn(s) + Ag_2O(s) + H_2O(l) \rightleftharpoons 2Ag(s) + Zn^{2+}(aq) + 2OH^-(aq)$$

If half-cell potentials are

$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$, $E^o = -0.76V$

$Ag_2O(s) + H_2O(l) + 2e^- \rightarrow 2Ag(s) + 2OH^-(aq)$, $E^o = 0.34V$

The cell potential will be

(a) 1.10V (b) 0.42V

(c) 0.84V (d) 1.34V

$E^0_{cell} = (E^0_{RP})_C - (E^0_{RP})_A$

$= 0.34 - (-0.76)$

$= +1.10V$

Q → $Cu^{+2} | Cu \rightarrow E^0_{RP} = 0.34V$ — ①

Ⓐ → $Zn^{+2} | Zn \rightarrow E^0_{RP} = -0.76V$ — ②

Ⓒ → $Ag^{+} | Ag \rightarrow E^0_{RP} = +0.80V$ — ③

Q-1 → Combine any two half cell and form Maximum cell Potential

$$(E^0_{cell})_{max} = (E^0_{RP})_C - (E^0_{RP})_A \Rightarrow 0.80 - (-0.76) = +1.56V$$

(↓ highest)

Q-2 Select Combination of half cell, which form max cell Potential

③ + ②

Ⓒ   Ⓐ

spontaneous of cell

$\Delta G = -ve \rightarrow$ spontaneous ,

$\Delta G = -nFE_{cell}$

$\Delta G^{\circ} = -nFE^{\circ}_{cell}$

<u>where</u> $\rightarrow$ n = total No. of e^- oxidise or reduce in cell rxn

F = Faraday's Constant

1F = 96500C

ΔG = Gibbs free energy

E_{cell} = Cell Potential

$\Delta G = -nFE_{cell}$

$\Delta G \downarrow -ve$; $E_{cell} \downarrow +ve$

$E_{cell} = +ve \rightarrow \Delta G = -ve \rightarrow$ spont^n

$E_{cell} = -ve \rightarrow \Delta G = +ve \rightarrow$ nonspont^n

$E_{cell} = 0 \rightarrow \Delta G = 0 \rightarrow$ at Equilibrium

Q37. Cell reaction is spontaneous when

$\Delta G = -ve$, $E_{cell} = +ve$

[CBSE AIPMT 2000]

(a) E_{red} is negative

(b) E_{red} is positive

(c) ΔG is negative

(d) ΔG is positive

Q30. A hypothetical electrochemical cell is shown below:

$A | A^+ (xM) || B^+ (yM) | B$ The EMF measured is +0.20V. The cell reaction

[CBSE AIPMT 2006]

$A \longrightarrow A^+ + e^-$

$B^+ + e^- \longrightarrow B$

(a) $A + B^+ \rightarrow A^+ + B$

(b) $A^+ + B \rightarrow A + B^+$

(c) $A^+ + e^- \rightarrow A, B^+ + e^- \rightarrow B$

(d) The cell reaction cannot be predicted

$A + B^+ \longrightarrow A^+ + B$

Q → $E_{Cu^{+2}|Cu} = 0.34V$ — (A)

$E_{Ag^+|Ag} = 0.80V$ — (C)

$E_{cell} = (E_{RP})_C - (E_{RP})_A$

Select the Correct cell, which is spontaneous

$= 0.80 - 0.34$

$= +0.46V$

a) $\overset{+1}{2Ag^+} + \overset{0}{Cu} \rightarrow \overset{0}{2Ag} + \overset{+2}{Cu^{+2}}$

b) $Cu^{+2} + 2Ag \rightarrow 2Ag^+ + Cu$

c) $2Ag^+ + Cu^{+2} \rightarrow 2Ag + Cu$

d) All

$\Delta G = -nFE_{cell}$

ΔG → $-ve$, E_{cell} → $+ve$

54. The standard Gibbs energy for the given cell reaction in kJ mol^{-1} at 298 K is

$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$,

$E^\circ = 2V$ at 298 K

(Faraday's constant, F = 96000 mol^{-1})

(2019 Main, 9 April I)

(A) 384

(B) 192

(C) –384

(D) –192

2e⁻

$\Delta G^\circ = -ve$

NEET-2025...

$\Delta G^\circ = -nFE^\circ_{cell}$

$= -2 \times 96000 \times 2$ Joule

$= -4 \times 96000 \times 10^{-3}$ KJ

$= -384$ KJ/mole

Nernst equation

7 NOV → Chhath puja
- → Chhutti
- → only
- → 8 NOV → Csd → fri
- → 9 NOV → Csd → Sat

Thank you!

MANTHAN NEET 2025

CHEMISTRY

ELECTROCHEMISTRY

Lecture-06

Qsd = ?



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Today's Goal -

Electrode potential
Gibbs free energy
Nernst equation
Concentration cell



Qsd-1 Electrode potential of cell is

a) Intensive prop^r

b) State function

c) depend upon con. of electrolyte

d) All

Qsd-2

$Zn^{+2} \longrightarrow Zn$, $E^{o}_{RP} = -0.76V$

$Cu^{+2} \longrightarrow Cu$, $E^{o}_{RP} = +0.34V$

best reducing agent

a) Zn

b) Zn^{+2}

c) Cu

d) Cu^{+2}

$R.A. \propto \frac{1}{E^{o}_{RP}}$

$\frac{?}{2}$

Nernst equation

Relation between E_{cell} & con. of electrolyte

telegram
Sarveshdixitcsd official
Csd → all

$$\Delta G = \Delta G^0 + RT \ln Q_c$$

$$\Delta G = -nF E_{cell}$$

$$\Delta G^0 = -nF E^0_{cell}$$

$$\frac{-nF E_{cell}}{-nF} = \frac{-nF E^0_{cell}}{-nF} + \frac{RT \ln Q_c}{-nF}$$

$$E_{cell} = E^0_{cell} - \frac{RT}{nF} \ln Q_c$$

$$E_{cell} = E^0_{cell} - \frac{RT}{nF} \ln Q_c$$

$R = 8.314$ Joule mole^{-1} K^{-1}

$F = 96500$ C

$T = 25^0$C or 298K (variable)

$$Zn(s) + Cu^{+2}(aq) \longrightarrow Zn^{+2}(aq) + Cu(s)$$

$$Q_c = \frac{[Zn^{+2}]}{[Cu^{+2}]}$$

$$E_{cell} = E^0_{cell} - \frac{0.0591}{n} \log Q_c$$

temp $= 25^0$ or 298K

$$Zn(s) + 2H^+(aq) \longrightarrow Zn^{+2}(aq) + H_2(g)$$

$$Q_c = \frac{[Zn^{+2}] \times (P_{H_2})^1}{[H^+]^2}$$

$C_{SD} \rightarrow \Delta G = \Delta G^{\circ} + RT \ln Q_c \rightarrow$

$$\rightarrow \boxed{E_{cell} = E^{\circ}_{cell} - \frac{RT}{nF} \ln Q_c}$$

$$\rightarrow \boxed{E_{cell} = E^{\circ}_{cell} - \frac{0.0591}{n} \log Q_c}$$

at 298 K temp → applicable

$E_{RP} = E^{\circ}_{RP} - \frac{0.0591}{n} \log Q_c$

$E_{OP} = E^{\circ}_{OP} - \frac{0.0591}{n} \log Q_c$

$$\boxed{E^{\circ}_{cell} = \frac{RT}{nF} \ln K_{eq} = \frac{0.0591}{n} \log K_{eq}}$$

Reactant → product ⇒ $Q_c = \frac{[prd]}{[Reactant]}$

$$\rightarrow \boxed{E_{cell} \propto \frac{1}{Q_c}}$$

Concentration cell = A & C = same half cell

$E^{\circ}_{cell} = 0$, $\Delta G^{\circ} = 0$

C_{SD}

$$E_{cell} = -\frac{0.0591}{n} \log Q_c$$

$\log x = +ve \rightarrow x > 1$

$\log x = -ve \rightarrow x < 1$

$\log x = 0 \rightarrow x = 1$

→ $Q_c < 1 \rightarrow E_{cell} = +ve$, $\Delta G = -ve \rightarrow$ spontaneous

→ $Q_c > 1 \rightarrow E_{cell} = -ve$, $\Delta G = +ve \rightarrow$ nonspontaneous

→ $Q_c = 1 \rightarrow E_{cell} = 0 \rightarrow \Delta G = 0 \rightarrow$ at Equilibrium

Q1. In the electrochemical cell Zn || $ZnSO_4$ (0.01M) || $CuSO_4$(1.0M)|Cu, the emf of this Daniel cell is E_1. When the concentration $ZnSO_4$ is changed to 1.0M and that of $CuSO_4$ changed to 0.01M, the emf changes to E_2. From the followings, which one is the relationship between E_1 and E_2? (Given, RT/F = 0.059)

[NEET 2017, 2003]

$Zn \longrightarrow Zn^{+2} \rightarrow (A)$ $0.01 = 10^{-2}$

(a) $E_1 = E_2$

$Cu^{+2} \longrightarrow Cu \rightarrow (C)$

(b) $E_1 < E_2$

(c) $E_1 > E_2$ ✓

(d) $E_2 = 0 \neq E_1$

$Zn(s) + Cu^{+2}(aq) \longrightarrow Zn^{+2}(aq) + Cu(s)$

$\rightarrow E_{cell} \propto \frac{1}{Q_c}$

$Q_c = \frac{[Zn^{+2}]}{[Cu^{+2}]} \Rightarrow \frac{10^{-2}}{1} \rightarrow E_1$, $\frac{1}{10^{-2}} = 10^{2} \rightarrow Q_c \rightarrow E_2$

$\rightarrow E_1 > E_2$

Q2. The pressure of H_2 required to make the potential of H_2-electrode zero in pure water at 298K is

E_{RP}

$\hookrightarrow H^+ = OH^- = 10^{-7}$

[CBSE AIPMT 2016, Phase I]

(a) 10^{-12} atm

(b) 10^{-10} atm

(c) 10^{-4} atm

(d) 10^{-14} atm

$E_{RP} = 0 \rightarrow P_{H_2} = ?$

$2H^+ + 2e^- \longrightarrow H_2(g)$

$E_{RP} = E^0_{RP} - \frac{0.0591}{n} \log Q_c$

$0 = 0 - \frac{0.0591}{2} \log \frac{P_{H_2}}{[H^+]^2}$

$\log \frac{P_{H_2}}{(10^{-7})^2} = 0,$

$\log \frac{P_{H_2}}{10^{-14}} = \log 1$

$P_{H_2} = 10^{-14}$ atm

E^0_{RP} or E^0_{OP} of $2H^+|H_2$ or $H_2|2H^+$ $= 0.00V$

Suppose kiya gaya hai

$\rightarrow E_{RP}$ or $E_{OP} \neq 0$

Q19. For the reduction of silver ions with copper metal, the standard cell potential was found to be +0.46V at 25°C. The value of standard Gibbs energy, ΔG^o will be ($F = 96500\ C\ mol^{-1}$)

E^o_{cell} ΔG^o

[CBSE AIPMT 2010]

$Cu + 2Ag^+ \rightarrow Cu^{+2} + 2Ag$

(a) –89.0 kJ (b) –89.0 J
(c) –44.5 kJ (d) 98.0 kJ

$$\Delta G^o = -nFE^o_{cell}$$
$$= -2 \times 96500 \times 0.46 \text{ Joule}$$
$$= -88780 \text{ Joule}$$
$$= -88.78 \text{ kJ}$$

Relation between Ecell and Keq.

$$\Delta G^\circ = -nFE^\circ_{cell}$$

$$\Delta G^\circ = -RT\ln K_{eq}$$

$$\cancel{-}nFE^\circ_{cell} = \cancel{-}RT\ln K_{eq}$$

$$E^\circ_{cell} = \frac{RT}{nF}\ln K_{eq} = \frac{0.0591}{n}\log K_{eq}$$

Q28. The equilibrium constant of the reaction,

$Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$, $E^o = 0.46$ V at 298 K is

[CBSE AIPMT 2007]

(a) 2.0×10^{10}

(b) 4.0×10^{10}

(c) 4.0×10^{15}

(d) 2.4×10^{10}

$(10)^{15+0.5}$

$10^{15} \times 10^{.5}$

$10^{\frac{1}{2}}$

$\sqrt{10}$

$E^0 = \frac{0.0591}{n} \log K_{eq}$

$0.46 = \frac{0.0591}{2} \log K_{eq}$

$\frac{0.92}{0.0591} = \log K_{eq}$, $\log K_{eq} = 15.56 = 15.5$ approx

$K_{eq} = (10)^{15.5}$

Q $Zn \mid Zn^{2+}\ (a = 0.1M) \parallel Fe^{2+}\ (a = 0.01M) \mid Fe.$

The emf of the above cell is 0.2905 V. Equilibrium constant for the cell reaction is

E_{cell} $\quad Zn + Fe^{+2} \rightarrow Zn^{+2} + Fe$

(2004, 1M)

(A) $10^{0.32/0.059}$

(B) $10^{0.32/0.0295}$

(C) $10^{0.26/0.0295}$

(D) $10^{0.32/0.295}$

$E_{cell} = E^{0}_{cell} - \frac{0.0591}{n} \log Q_c$

$0.2905 = E^{0} - \frac{0.0591}{2} \log \frac{0.1 \times 100}{0.01 \times 10}$

$E^{0}_{cell} = \frac{0.0591}{n} \log K_{eq}$

$0.32 = \frac{0.0591}{2} \log K_{eq}$

$0.32 = 0.0295 \log K_{eq}$

$0.2905 = E^{0} - \frac{0.0591}{2} \log 10$

$E^{0} = 0.2905 + \frac{0.0591}{2}$

$= 0.2905 + 0.0295$

$= 0.3200$

Concentration cell → If both half cell are same (Anode & Cathode)

Cell = Anode + Cathode

$Zn + Cu^{+2} \longrightarrow Zn^{+2} + Cu$

Cell = $Zn | Zn^{+2}$ || $Cu^{+2} | Cu$

($Zn | Zn^{+2}$ ↓ Anode; $Cu^{+2} | Cu$ ↓ Cathode)

Cell = $Zn | Zn^{+2}(10^{-2}M) || Zn^{+2}(10^{-4}M) | Zn(s)$

↓

Concentration cell

Ex → $H_2(g) \mid H^+(aq) \parallel H^+(aq) \mid H_2(g)$
(P atm) (C M) (C M) P atm

$E^\circ_{cell} = (E_{RP})_C - (E_{RP})_A$

$\Delta G^\circ = -nFE^\circ_{cell}$

Concentration cell

→ $E^\circ_{cell} = 0$, $\Delta G^\circ = 0$

→ $E_{cell} \neq 0$

Electrolyte Con. Cell

$H_2(g) \mid H^+(aq) \parallel H^+(aq) \mid H_2(g)$
1 atm 10^{-6} M 10^{-4} M 1 atm

→ Electrolyte Con. = different

→ $E^\circ_{cell} = 0$, $\Delta G^\circ = 0$

$E_{cell} \neq 0$

Electrode Con. Cell

$H_2(g) \mid H^+(aq) \parallel H^+(aq) \mid H_2(g)$
(1 atm) (1 M) 1 M 2 atm

Electrode Con. or pressure = different

$E^\circ_{cell} = 0$, $\Delta G^\circ = 0$

$E_{cell} \neq 0$

$$E_{cell} = -\frac{0.0591}{n} \log Q_c$$

$\log x = -ve$

$\rightarrow x < 1$

$\log x = +ve$

$x > 1$

$\Delta G = -nFE_{cell}$

$\rightarrow E_{cell} \propto \frac{1}{Q_c}$

$\rightarrow Q_c < 1 \rightarrow E_{cell} = +ve \rightarrow \Delta G = -ve \Rightarrow$ spont^n

$\rightarrow Q_c > 1 \rightarrow E_{cell} = -ve \rightarrow \Delta G = +ve \rightarrow$ nonspont^n

$\rightarrow Q_c = 1 \rightarrow E_{cell} = 0, \Delta G = 0 \rightarrow$ at Equilibrium

$$E_{cell} = -\frac{0.0591}{n} \log Q_c$$

$Q \rightarrow H_2(g) \mid H^+(aq) \parallel H^+(aq) \mid H_2(g)$

$C_1 M \qquad C_2 M$

$\Delta G = -ve \rightarrow E_{cell} = +ve$

Select the Correct relation b/w C_1 & C_2 for spontaneous of cell

$$E_{cell} = -\frac{0.0591}{n} \log Q_c$$

$$H_2 + 2H^+ \longrightarrow 2H^+ + H_2$$

$C_2 \qquad C_1$

$Q_c < 1 \rightarrow E_{cell} = +ve \rightarrow \Delta G = -ve$

a) $C_1 = C_2$

b) $C_1 > C_2$

c) $C_1 < C_2$

d) NONE

$$Q_c = \frac{P_{H_2} \times [H^+]^2}{P_{H_2} \times [H^+]^2} = \frac{C_1^2}{C_2^2}$$

$$Q_c = \frac{C_1^2}{C_2^2}$$

$$\frac{C_1^2}{C_2^2} < 1$$

$$C_1^2 < C_2^2$$

$$C_1 < C_2$$

Thank you!

MANTHAN NEET 2025

CHEMISTRY

ELECTROCHEMISTRY

Lecture-07

Qsd



Sarvesh Sir

Qsd-1 A) $2Ag^{+1} + 2e^- \rightleftharpoons 2Ag \rightarrow K_{eq} = 10^2$

B) $Cu^{+2} + 2e^- \rightleftharpoons Cu \rightarrow K_{eq} = 10^4$

which have max. E^0_{RP} value.

a) A

✓ b) B

c) both equal

d) NONE

$$E^0_{RP} = \frac{RT}{nF} \ln K_{eq}$$

$$E^0_{RP} \propto K_{eq}$$

Qsd-2

$H_2(g) \mid H^+(C_1 M) \parallel H^+(C_2 M) \mid H_2(g)$

Select Correct Condition for spontaneous of cell

$H_2 + H^+ \longrightarrow H^+ + H_2$

(H^+ on the left: C_2; H^+ on the right: C_1)

a) $C_1 = C_2$

b) $C_1 > C_2$

c) $C_1 < C_2$

d) NONE

$\Delta G = -nFE_{cell}$ (E_{cell}: +ve)

$Q_c = \frac{C_1}{C_2}$

$E = -\frac{0.0591}{n} \log Q_c$ (E: +ve; $\log Q_c$: -ve)

$Q_c < 1 \rightarrow \frac{C_1}{C_2} < 1 \Rightarrow C_1 < C_2$

$\frac{?}{2}$

ELECTRO-CHEMICAL SERIES

$E^\circ_{cell} = (E^\circ_{RP})_C - (E^\circ_{RP})_A$

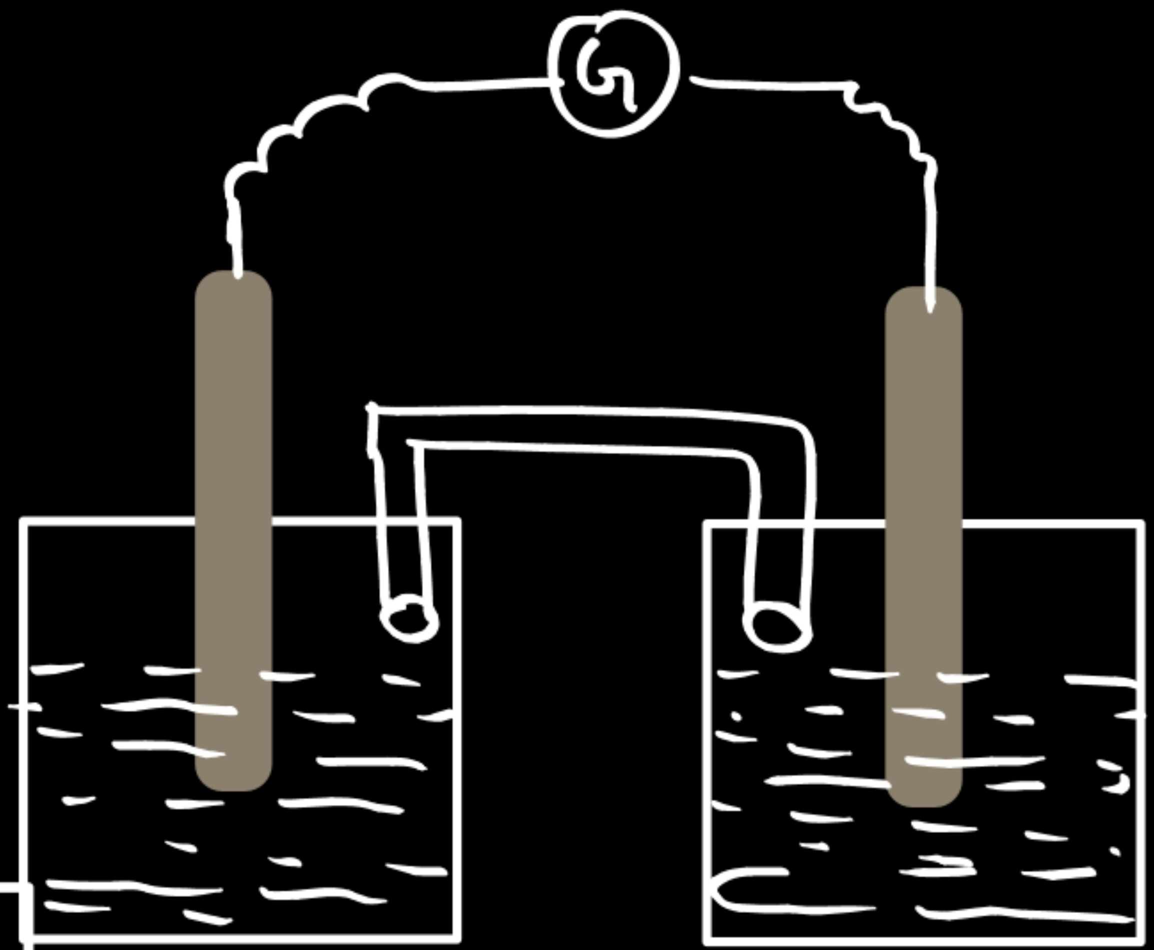
$(E^\circ_{RP})_A = 0.0V$ → suppose Kiya hai

$E^\circ_{cell} = (E^\circ_{RP})_C$

Refrence electrode → Hydrogen electrode

$H_2 | H^+ \rightarrow E^\circ_{OP} = 0.0V$, $H_2 | H^+ \rightarrow E_{OP} \neq 0$

$H^+ | H_2 \rightarrow E^\circ_{RP} = 0.0V$, $H^+ | H_2 - E_{RP} \neq 0$



Arrangement of E^{0}_{RP} of half cell in increasing order is Known as electro-chemical series (ECS-series)

Q . Zn cannot displace following ions from their aqueous solution

(A) Ag^{+} (B) Cu^{-2+}

(C) Fe^{2+} (D) Na^{+}

$Zn + Ag^{+} \rightarrow Ag + Zn^{+2}$

$Zn + Cu^{+2} \rightarrow Cu + Zn^{+2}$

$Zn + Fe^{+2} \rightarrow Fe + Zn^{+2}$

(X) $Zn + Na^{+} \rightarrow$

Electrolysis (electrolytic cell)

Electrolyticcell → one compartment

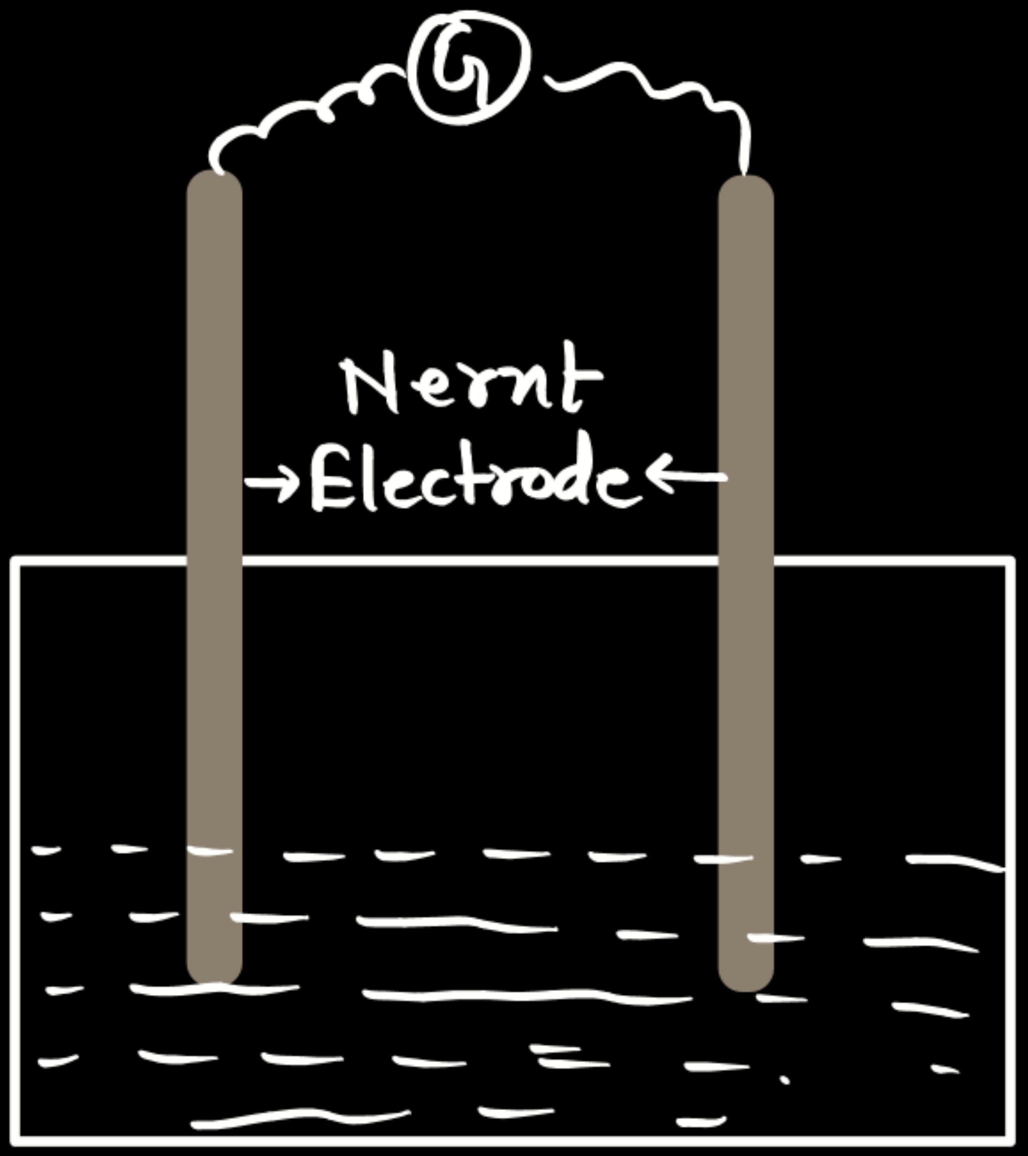
→ Common electrolyte soln

→ 2-electrode → same Compartment

→ work in presence of external agent

electrochemical cell → Anode → (−) , Cathode → (+)

Electrolytic cell → Anode → (+) , Cathode → (−)



E^{o}_{RP}

−3.02eV	Li → $Li^{+}\|Li$	→ liver	→	लीवर
−2.98eV	K → $K^{+}\|K$	→ pascent	→	पैसंट
	Ba → $Ba^{+2}\|Ba$	→ BaBa	→	बाबा
	Sr → $Sr^{+2}\|Sr$	→ Sehgal	→	सहेगल
	Ca → $Ca^{+2}\|Ca$	→ Kumar	→	कुमार
	Na → $Na^{+1}\|Na$	→ Sonu	→	सोनू

⋮

* increasing order of E^{o}_{RP} of half cell [redacted]

* upper → E^{o}_{RP} = −ve
  $H^{+}|H_2$ → E^{o}_{RP} = 0.0V
  nichhe → E^{o}_{RP} = +ve

* Jo nichhe hai = Reduction hoga

Ex → $Zn + Cu^{+2} \rightarrow Zn^{+2} + Cu$
  └ cell = spont^n

Ex → $Cu + Zn^{+2} \rightarrow Cu^{+2} + Zn$
  → cell = nonspont^n
  └ not possible

$Mg \longrightarrow Mg^{+2}|Mg \longrightarrow$ Mohammed → मोहम्मद

$Al \longrightarrow Al^{+3}|Al \longrightarrow$ Ali → अली

$Mn \longrightarrow Mn^{+2}|Mn \longrightarrow$ Mumbai → मुम्बई

$Zn \longrightarrow Zn^{+2}|Zn \longrightarrow$ Za Kr → जाकर

$Cr \longrightarrow Cr^{+3}|Cr \longrightarrow$ Chromosome → क्रोमोसोम

$Fe \longrightarrow Fe^{+2}|Fe \longrightarrow$ Iron Ki → आरन की

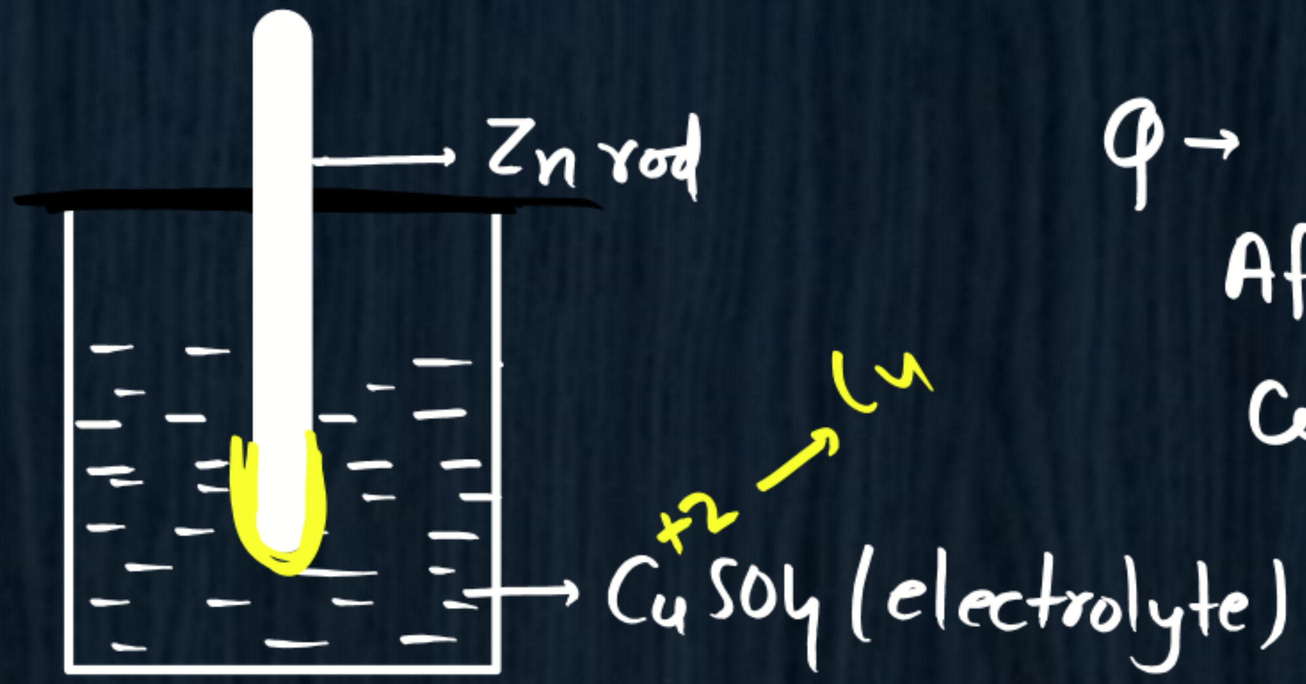
E^{o}_{RP}

Cd →	$Cd^{+2}\|Cd$ →	Kedny	→	कितनी
Co →	$Co^{+2}\|Co$ →	Ko	→	को
Ni →	$Ni^{+2}\|Ni$ →	nikalwa Kr	→	निकलवाकर
Sn →	$Sn^{+2}\|Sn$ →	Tino	→	तीनो
Pb →	$Pb^{+2}\|Pb$ →	log	→	लोग
⇒ 0.00 eV H →	$H^{+}\|H_2$ →	High	→	हाई

E^{o}_{RP}

+0.34eV $Cu \longrightarrow$	$Cu^{+2}\vert Cu \longrightarrow$	Capsule	$\longrightarrow$	कैप्सूल
$Hg \longrightarrow$	$Hg^{+2}\vert Hg \longrightarrow$	Hum se lene	$\longrightarrow$	हम से लेने
$Ag \longrightarrow$	$Ag^{+1}\vert Ag \longrightarrow$	silver Ka	$\longrightarrow$	सिल्वर का
$Pt \longrightarrow$	$Pt^{+2}\vert Pt \longrightarrow$	Patiyala	$\longrightarrow$	पटियाला
$Au \longrightarrow$	$Au^{+3}\vert Au \longrightarrow$	Aaye	$\longrightarrow$	आए

Q



Q → Zn-rod dipped in $CuSO_4$ blue sol^n

After some time blue sol^n → Convert into Colourless sol^n.

a) $Cu^{+2} \longrightarrow Cu(s)$

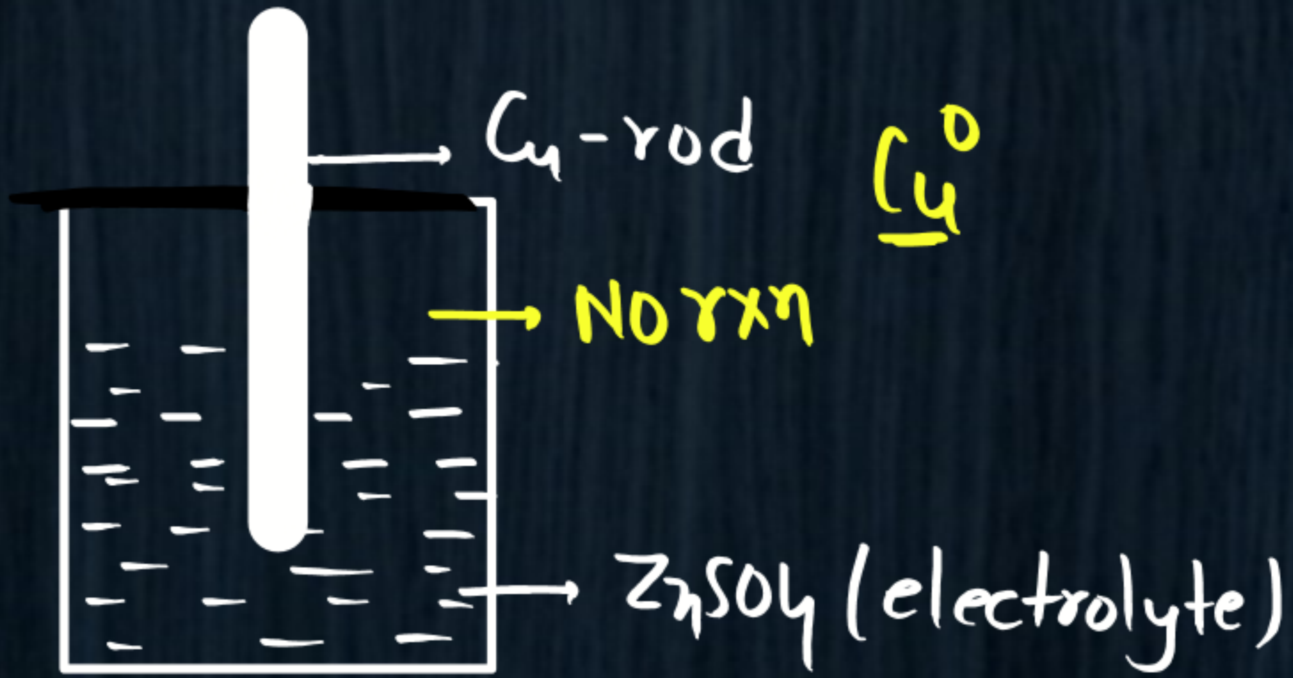
b) $Zn \longrightarrow Zn^{+2}$

c) both Correct

Cu^{+2} (aq)
↓
blue colour

$$Cu^{+2} \longrightarrow Cu$$
$$Zn \longrightarrow Zn^{+2}$$
$$Cu^{+2} + Zn \rightarrow Cu + Zn^{+2}$$

Q →



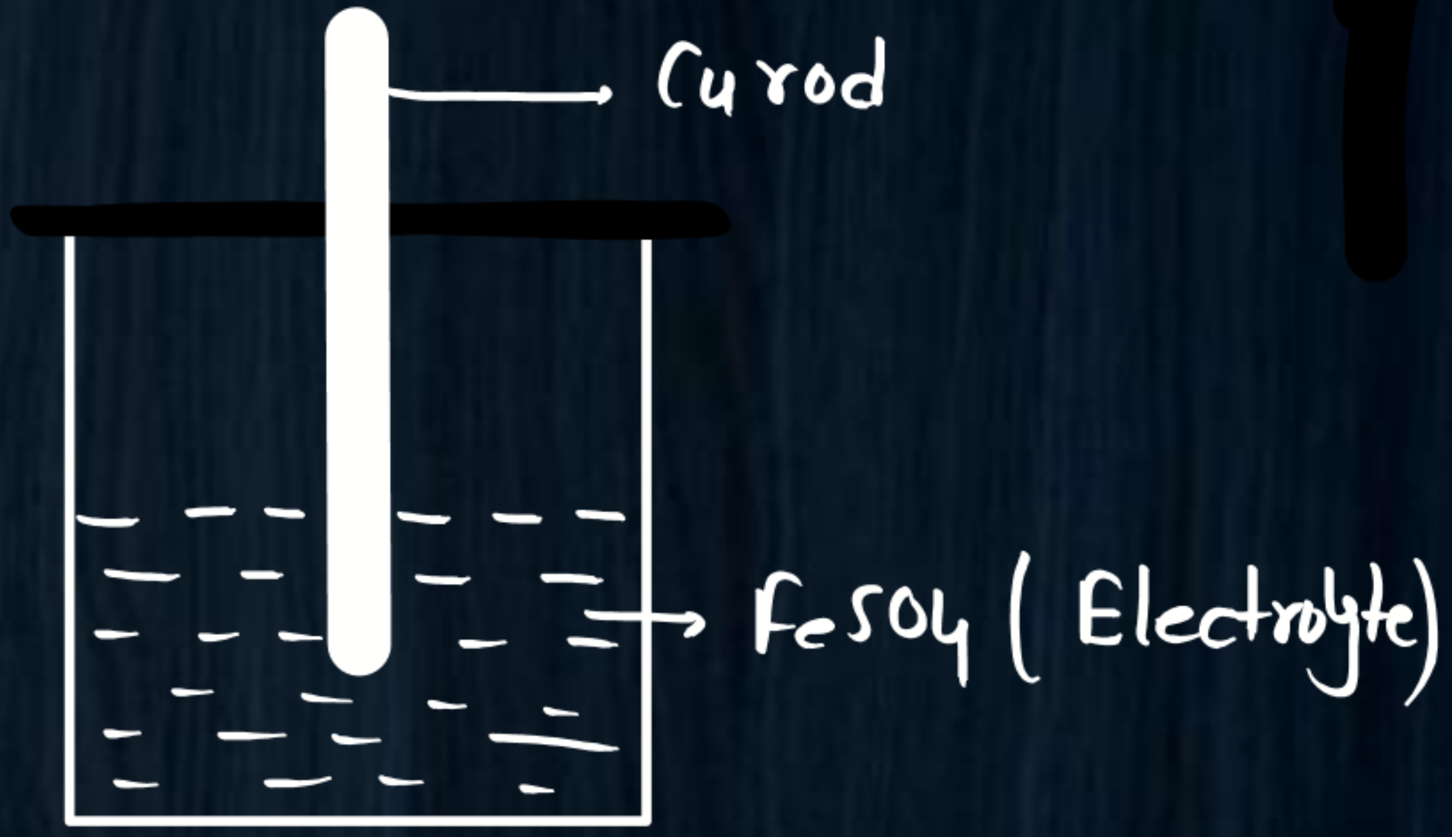
Q. If a spoon of copper metal is placed in a solution of ferrous sulphate

(A) Cu will precipitate out

(B) ✗ Iron will precipitate

(C) ✗ Cu and Fe will precipitate

(D) ✓ No reaction will take place



Cu-metal → Cu^0

$Fe^{+2}(aq)$

$Cu^{+2}(aq) \longrightarrow Cu(s)$

Fe(s)

Q → Iron spoon is placed in $CuSO_4$ soln

option → same option

Ans ⇒ ①

Ex → aq NaCl sol^n → electrolyte

Cation = Na^+, H^+ ⇒ Reduction $2H^+ + 2e^- \rightarrow H_2\uparrow$ – Cathode

Anion = Cl^-, OH^- ⇒ Oxidation ⇒ $2Cl^- \rightarrow Cl_2\uparrow + 2e^-$ → Anode

$2H^+ + 2Cl^- \rightarrow H_2\uparrow_{(g)} + Cl_2\uparrow_{(g)}$

Note $2X^- \rightarrow X_2\uparrow + 2e^-$

$4OH^- \rightarrow O_2\uparrow(g) + 2H_2O(l) + 4e^-$

Yadi halogen, to halogen Ka oxidation hoga

nahito OH^- Ka oxidation hoga

Aqueous NaCl → electrolyte

Q-1 → Anode rxn = $2Cl^- \rightarrow Cl_2\uparrow + 2e^-$

Q-2 → Cathode rxn = $2H^+ + 2e^- \longrightarrow H_2\uparrow$

Q-3 → which gas release at Anode → $Cl_2\uparrow$

Q-4 → which gas release at Cathode → $H_2\uparrow$

Q-5 → Con. of Na^+ ion After electrolysis a> increase b> decreases c> same ✓

Q-6 pH of soln After electrolysis → a> increase ✓ b> decrease

Q-7

$$pH = -\log H^+ = \log \frac{1}{H^+}$$

Ex → aqueous $CuSO_4$ solⁿ

Cation = Cu^{+2}, H^+ $\quad (Cu^{+2} + 2e^- \rightarrow Cu \Rightarrow$ Cathode $) \times 2$

Anion = OH^-, SO_4^{-2} $\quad 4OH^- \longrightarrow O_2\uparrow + 2H_2O + 4e^-$ = Anode

$$2Cu^{+2} + 4OH^- \longrightarrow Cu + O_2 + 2H_2O$$

Ex → fused or molten NaCl

Cation = Na^+ $\Rightarrow (Na^+ + e^- \rightarrow Na(s)) \times 2$

Anion = Cl^- $\Rightarrow 2Cl^- \rightarrow Cl_2 + 2e^-$

$$2Na^+ + 2Cl^- \rightarrow 2Na + Cl_2$$

Q. A solution of sodium sulphate in water is electrolysed using inert electrodes. The product at the cathode and anode are respectively

(A) H_2, SO_2 (B) O_2, H_2

(C) O_2, Na (D) H_2, O_2

Na_2SO_4 (aq)

Cation = Na^+, H^+ → $(2H^+ + 2e^- \rightarrow H_2\uparrow) \times 2$

Anion = SO_4^{-2}, OH^- → $4OH^- \rightarrow O_2\uparrow + 2H_2O + 4e^-$

$4H^+ + 4OH^- \rightarrow 2H_2\uparrow + O_2\uparrow + 2H_2O$

Q. A solution of sodium chloride in water is electrolysed using inert electrodes. The pH of solution after elcetrolysis

(A) increase (B) decreases

(C) 2 times of initial pH (D) does not change

H.W.

MANTHAN NEET 2025

CHEMISTRY

ELECTROCHEMISTRY

Lecture-08



Sarvesh Sir

Q51 A solution of sodium chloride in water is electrolysed using inert electrodes. The pH of solution after elcetrolysis

(A) ✓ increase (B) decreases

(C) 2 times of initial pH (D) does not change

aq NaCl electrolysis

Cation → H^+, Na^+ ⇒ $2H^+ + 2e^- \rightarrow H_2\uparrow$

Anion → OH^-, Cl^- ⇒ $2Cl^- \rightarrow Cl_2 + 2e^-$

$2H^+ + 2Cl^- \rightarrow H_2 + Cl_2$

↑ $pH = -\log[H^+] = \log\frac{1}{[H^+]\downarrow}$

Qsd-2 In electrolysis of molten NaCl, which gas release at cathode

a) Cl_2

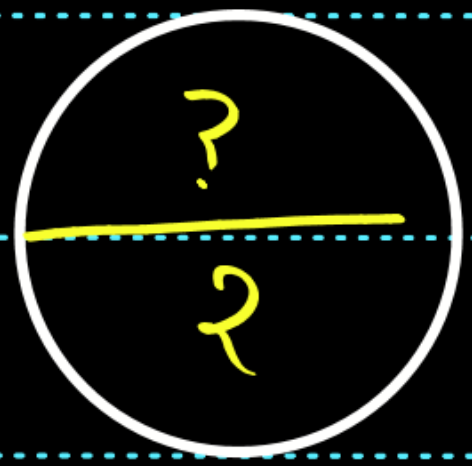
b) H_2

c) O_2

d) NONE ✓

Cation → Na^+ → Cathode (Red) $Na^+ + e^- \rightarrow Na(s)$

Anion → Cl^-



Faraday's law

quantative analysis → electrolysis

1st Law "total amount deposite/release is directly proportional to charge utilise."

$$W \propto q_{actual}$$

$$W = Z \times q_{actual} \qquad (q_{act} = i_{actual} \times t)$$

Z = electrochemical const

$$W = Z \times i_a \times t$$

$$\text{Current efficiency} = \frac{i_{actual}}{i_{initial}} \times 100$$

$$i_{actual} = \frac{\text{Current efficiency} \times i}{100}$$

Q → 2 Amp current pas in electrolysis process with current efficiency 80%. What is real current utilise by electrolysis

a) 1.6 amp b) 2 amp.

$$i_a = \frac{80 \times 2}{100} = 1.6$$

Note 1F = 96500 C = Charge of 1 mole e^- utilised = alway 1 gram

Equivalent = (E·wt) gram = $\left(\frac{M \cdot wt}{n}\right)$ gram deposite / release

Cation ⇒ $E \cdot wt = \frac{A \cdot wt}{\text{Charge of Cation}}$

$Cu^{+2} \rightarrow E \cdot wt = \frac{A \cdot wt}{2} = \frac{63.5}{2}$

$Ag^{+} \rightarrow E \cdot wt = \frac{A \cdot wt}{1} = \frac{108}{1}$

$Fe^{+2} \Rightarrow E \cdot wt = \frac{56}{2}$

$2H^+ + \underline{2e^-} \rightarrow H_2\uparrow \rightarrow n_{H_2} = 2$

$2X^- \longrightarrow \uparrow X_2 + 2e^- \rightarrow n_{X_2} = 2$

$4OH^- \longrightarrow \uparrow O_2 + 2H_2O + 4e^-,\ n_{O_2} = 4$

$W = Z \times q$

$q = 1F = 96500\,C$

$W = E.wt$ gram

$E.wt = Z \times 96500$

$$Z = \frac{E.wt}{96500}$$

$$W = \frac{E.wt}{96500} \times q = \frac{E.wt}{96500} \times i \times t$$

$$\frac{W}{E.wt} = \frac{q}{96500}$$

*** No. of gram Eq. $= \dfrac{q}{96500}$

η-factor × No. of mole deposite/gas release $= \dfrac{q}{96500}$

CSDI 1st law of faraday → $W \propto q_{actual}$

→ $q_a = i_{actual} \times t$

$i_{actual} = \frac{\text{Current efficiency}}{100} \times i_{pas}$

***

→ 1F = 96500 C = 1 mole charge of e^- pas in electrolysis = Always 1 gram Eq = (E·Wt) gram

$= \left(\frac{A \cdot Wt}{\eta}\right)$ gram mass deposited | gas release →

***

→ $\eta \times$ No. of mole deposited or gas release $= \frac{q}{1F} = \frac{q}{96500}$

$W = \frac{E \cdot Wt}{96500} \times i \times t$

***

→ No. of gram Eq. of Anode = No. of gram Eq. of Cathode

Q→ How many gram of Cu deposite at Cathode when 1F charge pas in electrolysis of aq. $CuSO_4$ ($Cu = 63.5$)

a> 63.5g

b> 31.75g ✓

c> 137.0g

d> NONE

$1F = E.wt\ gram = \frac{A.wt}{n}\ gram$

$= \frac{63.5}{2} = 31.75\ gram$

13:3

21. The electric charge for electrode deposition of one gram equivalent of a substance is

$1F = 96500C$

(1984, 1M)

(A) one ampere per second

(B) 96,500 coulombs per second → $i = 96500$

(C) one ampere for one hour

(D) charge on one mole of electrons

or

96500 C → Charge

$\frac{q}{t} \rightarrow \frac{96500C}{1 sec} = i$

$q = it$

$i = \frac{q}{t}$ = Charge pr sec

Q. The desired amount of charge for obtaining one mole of Al from Al+3

(A) 3 × 96500 C (B) 96500 C

(C) 96500 C (D) 96500 C

$Al^{+3} \rightarrow Al$

$\eta \times \text{No. of mole} = \frac{q}{96500}$

$3 \times 1 = \frac{q}{96500}$

$q = 3 \times 96500 C$

2. A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using 0.1 Faraday electricity. How many mole of Ni will be deposited at the cathode?

↓ q

Ni^{+2}

(2019 Main, 9 April II)

↓ NEET-2025

(A) 0.20
(B) 0.10
(C) 0.15
(D) 0.05

$n \times \text{No. of mole} = \frac{q}{1F}$

$2 \times \text{No. of mole of Ni} = \frac{0.1}{1}$

$\text{Mole of Ni} = \frac{0.1}{2} = 0.05 \text{ mole}$

$Cu^{+2}(aq) + 2e^-$
↓
$Cu(s)$

$Cu^{+2} + 2e^-$
$Cu^{+2} + 2e^-$
$Cu^{+2} + 2e^-$
$Cu^{+2} + 2e^-$

10. Two Faraday of electricity is passed through a solution of $CuSO_4$. The mass of copper deposited at the cathode is
(at. mass of Cu = 63.5 u)

Cu^{+2}

(2015 Main)

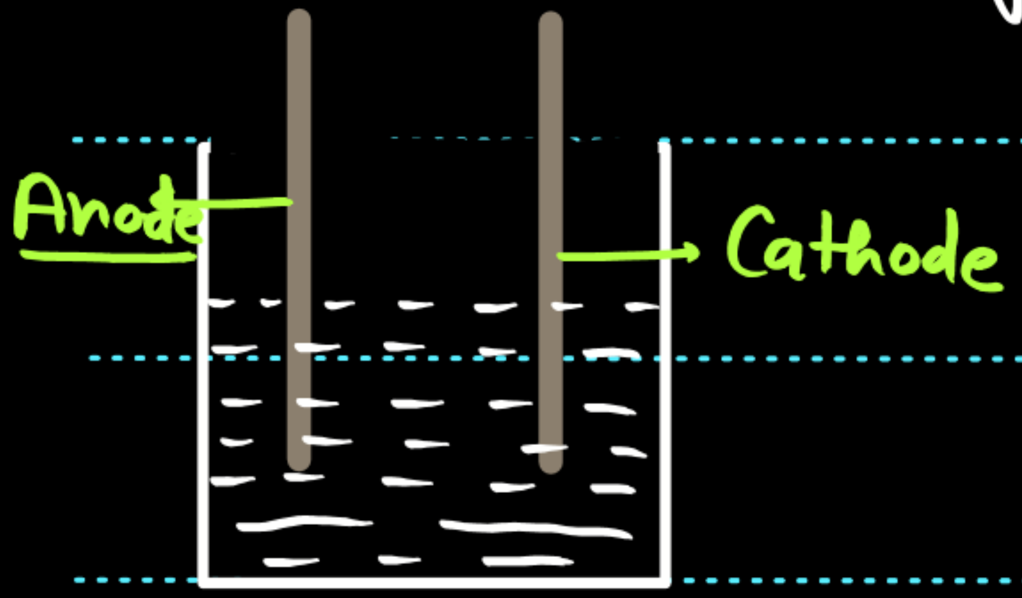
(A) 0 g
(B) 63.5 g
(C) 2 g
(D) 127 g

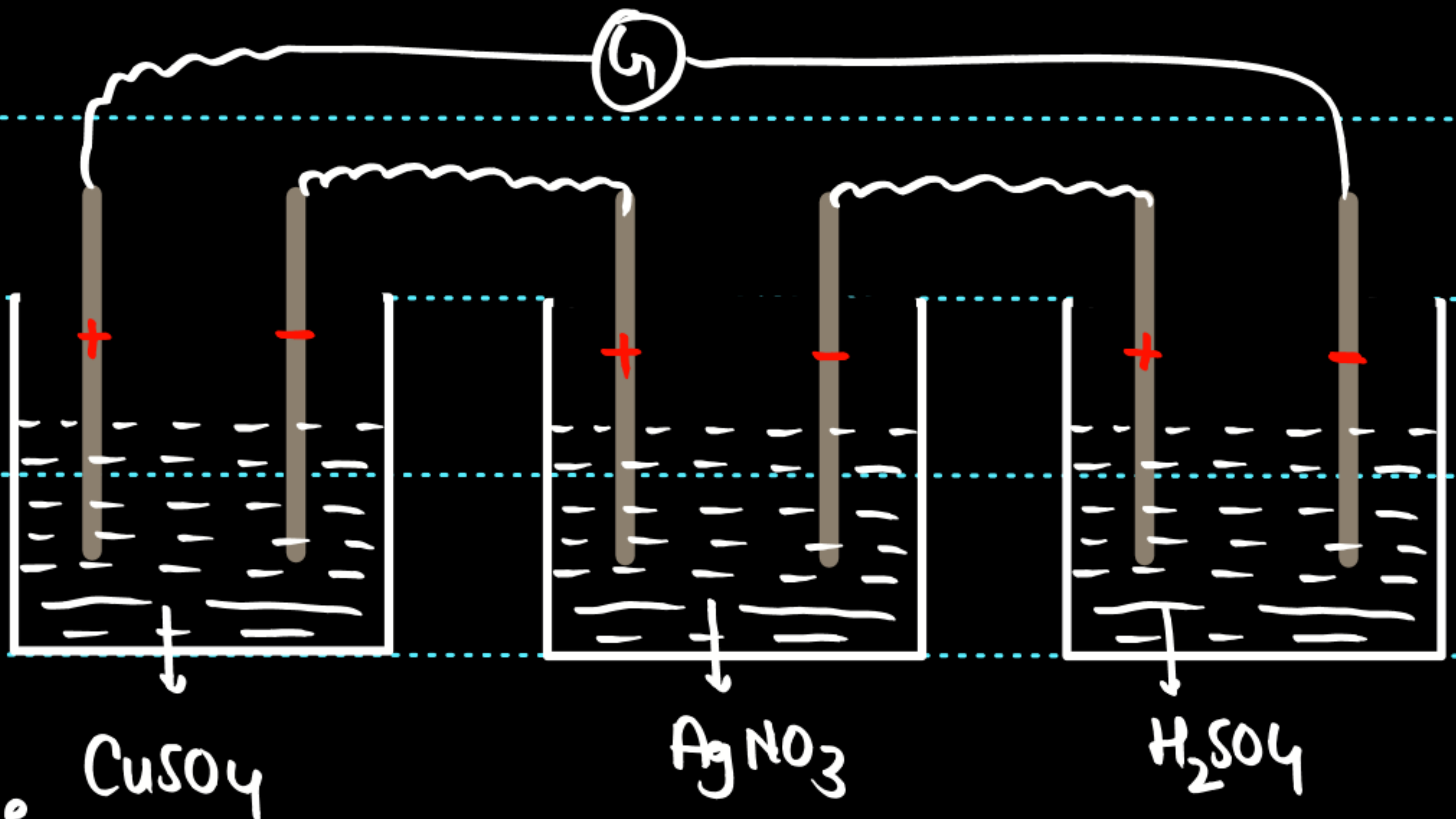
$$\eta \times \text{mole} = \frac{q}{1F}$$

$$2 \times \frac{W}{63.5} = \frac{2F}{1F}$$

$$W = 63.5 g$$

2nd law of faraday





Series arrangement = q = same

> No. of gram Eq. of Cathode
> ||
> No. of gram Eq. of Anode

No. of gram Eq. Cu deposite = No. of gram Eq. of Ag deposite

= No. of gram Eq. of H_2 gas release

$$n_{Cu} \times M_{Cu} = n_{Ag} \times M_{Ag} = n_{H_2} \times M_{H_2}$$

Q → What volume of O_2 gas release at Anode at S.T.P. in electrolysis of aq $CuSO_4$ solution. If 6.35 gram Cu-deposite at Cathode in Complete electrolysis

$$4\overset{-2}{OH^-} \rightarrow \uparrow \overset{0}{O_2} + 2H_2O + \underline{4e^-}$$

a) 2.24 L

b) 11.2 L

c) 1.12 L ✓

d) NONE

aq. $CuSO_4$ → Cathode = 6.35 g Cu

Anode = $O_2 \uparrow$ = ?

$$n_{Cu} \times (\text{mole})_{Cu} = n_{O_2} \times (\text{mole})_{O_2}$$

$$2 \times \frac{6.35}{63.5} = 4 \times \frac{V_g}{22.4}$$

(0.1; 2)

$$V_g = \frac{2.24}{2} = \underline{1.12L}$$

Q. On passing electricity through dilute H_2SO_4 solution the amount of substance liberated at the cathode and anode are in the ratio

(A) 1 : 8 (B) 8 : 1

(C) 16 : 1 (D) 1 : 16

$H_2SO_4 \rightarrow$ Cation $\rightarrow H^+ \Rightarrow 2H^+ + 2e^- \longrightarrow H_2\uparrow \rightarrow$ (C)

$\rightarrow$ Anion $\rightarrow OH^-, SO_4^{-2} \Rightarrow 4OH^- \longrightarrow O_2 + 2H_2O + 4e^- \quad$ — (A)

$$n_{H_2} \times M_{H_2} = n_{O_2} \times M_{O_2}$$

$$2 \times \frac{W_{H_2}}{2} = 4 \times \frac{W_{O_2}}{32}$$

$$\frac{W_{H_2}}{W_{O_2}} = \frac{1}{8}$$

Q → 3-Cell arrange in series
1) aq $CuSO_4$
2) aq. $AgNO_3$
3) aq. $Al_2(SO_4)_3$

What ratio of mole Cu, Ag & Al deposite in cathode of 1F charge pas

a) 1:2:3
b) 1:6:2
c) 6:3:2
d) NONE

$$n_{Cu} \times (mole)_{Cu} = n_{Ag} \times (mole)_{Ag} = n_{Al} \times (mole)_{Al} = x$$

$(mole)_{Cu} = \frac{x}{2}$

$(mole)_{Ag} = \frac{x}{1}$

$(mole)_{Al} = \frac{x}{3}$

$\therefore \frac{x}{2} : \frac{x}{1} : \frac{x}{3}$

$\frac{3:6:2}{6} = 3:6:2$

Q → in electrolysis of $Al_2(SO_4)$ solution, 3 mole of Al deposite at Cathode, what mole of O_2 gas release at Anode

a) 4 mole

b) 3 mole

~~c)~~ $\frac{9}{4}$ mole

d) $\frac{4}{9}$ mole

$$n_{Al} \times m_{Al} = n_{O_2} \times M_{O_2}$$

$$3 \times 3 = 4 \times (\text{mole})_{O_2}$$

$$\text{mole of } O_2 = \frac{9}{4} \text{ mole}$$

Battery

7pm Live U-tube

Sankalp neet vedantu

One shot = Chemical Kinetics

Thank you!

MANTHAN NEET 2025

CHEMISTRY

ELECTROCHEMISTRY

Lecture-09



Sarvesh Sir

SANKALP NEET VEDANTU

TOPICS TO BE COVERED



Complete chapter

Battery

When No. of galvanic cell arrange in series, this Combination of cell is called battery

2 type of battery

1) Primary battery ⇒ not Reacharge → unreachargable battery

2) Secondary battery ⇒ Reachargable buttery =

Anode → Zn

Cathode → graphite rod

Cell Rxn

Ecell = 1.5 eV → decrease during use

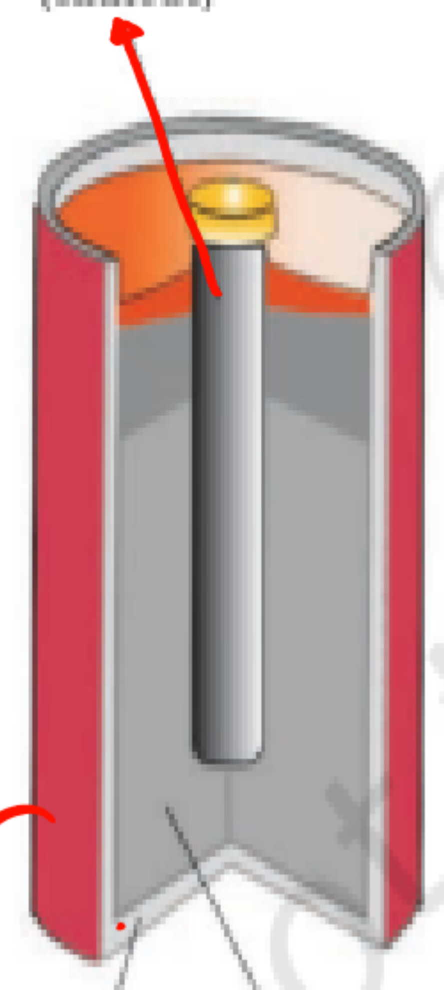
Electrolyte = $MnO_2 + NH_4Cl$ paste

$Zn \rightarrow Zn^{+2} + 2e^-$ — (A)

$MnO_2 + NH_4^+ \rightarrow MnO(OH) + NH_3\uparrow$ — (C)

3.6.1 Primary Batteries

In the primary batteries, the reaction occurs only once and after use over a period of time battery becomes dead and cannot be reused again. The most familiar example of this type is the dry cell (known as Leclanche cell after its discoverer) which is used commonly in our transistors and clocks. The cell consists of a zinc container that also acts as anode and the cathode is a carbon (graphite) rod surrounded by powdered manganese dioxide and carbon (Fig.3.8). The space between the electrodes is filled by a moist paste of ammonium chloride (NH_4Cl) and zinc chloride ($ZnCl_2$). The electrode reactions are complex, but they can be written approximately as follows :



Anode: $Zn(s) \longrightarrow Zn^{2+} + 2e^-$

Cathode: $MnO_2 + NH_4^+ + e^- \longrightarrow MnO(OH) + NH_3$

+4 +2

In the reaction at cathode, manganese is reduced from the + 4 oxidation state to the +3 state. Ammonia produced in the reaction forms a complex with Zn^{2+} to give $[Zn(NH_3)_4]^{2+}$. The cell has a potential of nearly 1.5 V.

Mercury cell, (Fig. 3.9) suitable for low current devices like hearing aids, watches, etc. consists of zinc – mercury amalgam as anode and a paste of HgO and carbon as the

Anode → Zn-Hg

$Zn\text{-}Hg \longrightarrow Zn^{+2} + Hg$

Cathode → HgO

$HgO \longrightarrow Hg + O$

Electrolyte → KOH

Cell Rxn = $Zn\text{-}Hg_{(s)} + HgO_{(s)} \rightarrow ZnO_{(s)} + Hg_{(l)}$

Ecell = 1.35V → during used = Constant → $E_{cell} = E^{0}_{cell}$ = Const

2) Button cell → Ex. of primary cell (Zn-Hg)

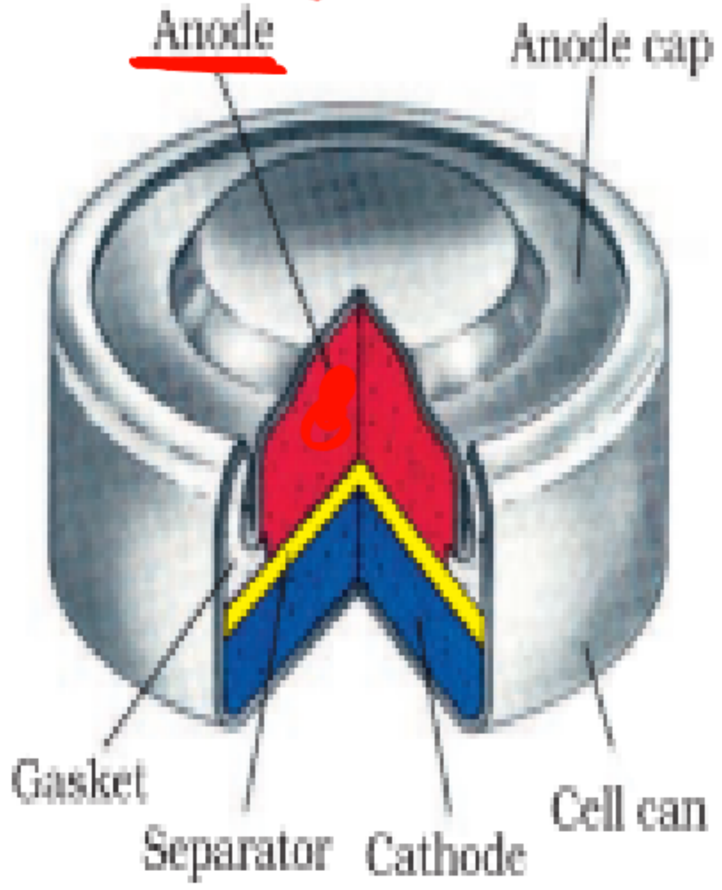


Fig. 3.9 Commonly used mercury cell. The reducing agent is zinc and the oxidising agent is mercury (II) oxide.

The overall reaction is represented by

$$Zn(Hg) + HgO(s) \longrightarrow ZnO(s) + Hg(l)$$

The cell potential is approximately 1.35 V and remains constant during its life as the overall reaction does not involve any ion in solution whose concentration can change during its life time.

Anode → Pb-rod (plate)



$\overset{0}{Pb} + H_2SO_4 \rightarrow \overset{+2}{PbSO_4}$

Cathode →



$\overset{+4}{PbO_2} + H_2SO_4 \rightarrow \overset{+2}{PbSO_4}$

Electrolyte = 38% (w/w) H_2SO_4

E_{cell} = 2.04V → during use → E_{cell} = decrease

Cell Rxn ⇒ $Pb + PbO_2 + H_2SO_4$
↓
$2PbSO_4 + 2H_2O$ → discharge Reaction ⇒ (C.E → E.E)

3.6.2 Secondary Batteries

Lead Storage battery

A secondary cell after use can be recharged by passing current through it in the opposite direction so that it can be used again. A good secondary cell can undergo a large number of discharging and charging cycles. The most important secondary cell is the lead storage battery (Fig. 3.10) commonly used in automobiles and invertors. It consists of a lead anode and a grid of lead packed with lead dioxide (PbO_2) as cathode. A 38% solution of sulphuric acid is used as an electrolyte.

The cell reactions when the battery is in use are given below:

Anode: $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$

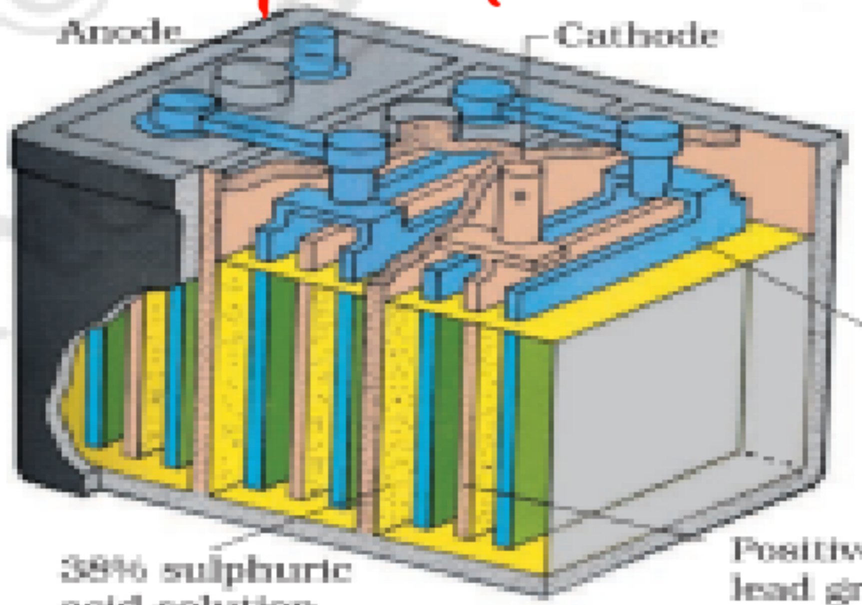
Cathode: $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$

i.e., overall cell reaction consisting of cathode and anode reactions is:

$Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$

On charging the battery the reaction is reversed and $PbSO_4(s)$ on anode and cathode is converted into Pb and PbO_2, respectively.

Reacharge Rxn → $2PbSO_4 + 2H_2O \rightarrow Pb + PbO_2 + H_2SO_4$



E.E → C.E (store ho rahi hai)

Fuel cell → It is a device, which is Convert thermal energy into electrical energy

$$\overset{0}{2H_2} + \overset{0}{O_2} \longrightarrow \overset{+1\,-2}{2H_2O},\quad \Delta H = -ve \text{ (highly exothermic)}$$

↓ ∴ Convert into electrical energy

Ex→ Hydrogen-oxygen fuel cell

→ $H_2O(l)$ → distilled H_2O(

$Cd\ (s) + 2Ni(OH)_3\ (s) \rightarrow CdO\ (s) + 2Ni(OH)_2\ (s) + H_2O\ (l)$

3.7 Fuel Cells

Production of electricity by thermal plants is not a very efficient method and is a major source of pollution. In such plants, the chemical energy (heat of combustion) of fossil fuels (coal, gas or oil) is first used for converting water into high pressure steam. This is then used to run a turbine to produce electricity. We know that a galvanic cell directly converts chemical energy into electricity and is highly efficient. It is now possible to make such cells in which reactants are fed continuously to the electrodes and products are removed continuously from the electrolyte compartment. Galvanic cells that are designed to convert the energy of combustion of fuels like hydrogen, methane, methanol, etc. directly into electrical energy are called fuel cells.

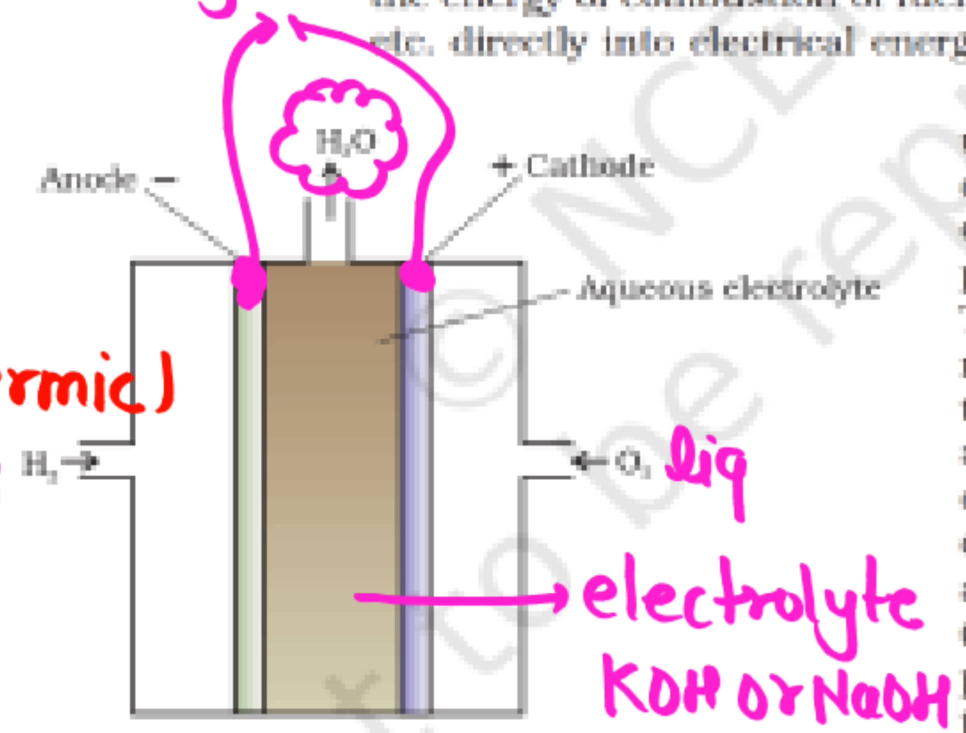


Fig. 3.12: Fuel cell using H_2 and O_2 produces electricity.

One of the most successful fuel cells uses the reaction of hydrogen with oxygen to form water (Fig. 3.12). The cell was used for providing electrical power in the Apollo space programme. The water vapours produced during the reaction were condensed and added to the drinking water supply for the astronauts. In the cell, hydrogen and oxygen are bubbled through porous carbon electrodes into concentrated aqueous sodium hydroxide solution. Catalysts like finely divided platinum or palladium metal are incorporated into the electrodes for increasing the rate of electrode reactions. The electrode reactions are given below:

→ Cathode: $O_2(g) + 2H_2O(l) + 4e^- \longrightarrow 4OH^-(aq)$

→ Anode: $2H_2\ (g) + 4OH^-(aq) \longrightarrow 4H_2O(l) + 4e^-$

Cell → Overall reaction being:

$2H_2(g) + O_2(g) \longrightarrow 2\ H_2O(l)$, $\Delta H = -ve$

Efficiency of fuel cell → Kitne % me aap thermal Energy Ko electrical Energy Convert Krte ho.

$$\text{efficiency of fuel cell} = \frac{\Delta H}{\Delta G} \times 100 = \frac{\text{Enthalpy of Rxn}}{\Delta G\,(-nFE_{cell})} \times 100$$

Ex → H-O-fuel → efficiency = 70% $(\Delta G = -nFE_{cell})$

Corrosion

Metal + atomsphere (Air)

↓ spontaneous slow process

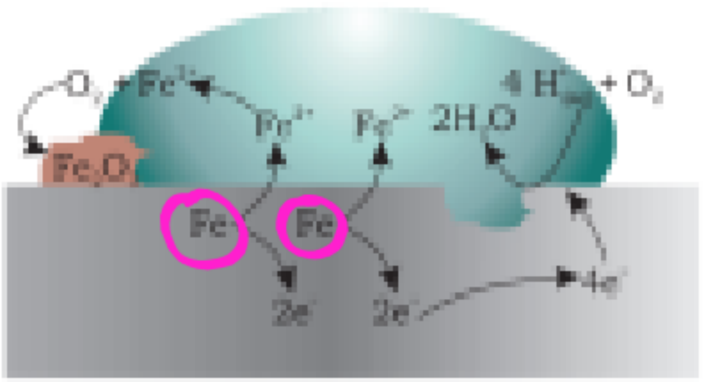
Metal oxide or metal Carbonate or metal sulphate etc.

Metal tendency to react with air slowly and form metal oxide or metal carbonet etc, this process is called Corrosion

3.8 Corrosion

Rusting of Fe

Corrosion slowly coats the surfaces of metallic objects with oxides or other salts of the metal. The rusting of iron, tarnishing of silver, development of green coating on copper and bronze are some of the examples of corrosion. It causes enormous damage to buildings, bridges, ships and to all objects made of metals especially that of iron. We lose crores of rupees every year on account of corrosion.



Oxidation: $Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$

Reduction: $O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2H_2O(l)$

Atomospheric oxidation: $2Fe^{2+}(aq) + 2H_2O(l) + \frac{1}{2}O_2(g) \rightarrow Fe_2O_3(s) + 4H^+(aq)$

Fig. 3.13: Corrosion of iron in atmosphere

In corrosion, a metal is oxidised by loss of electrons to oxygen and formation of oxides. Corrosion of iron (commonly known as rusting) occurs in presence of water and air. The chemistry of corrosion is quite complex but it may be considered essentially as an electrochemical phenomenon. At a particular spot (Fig. 3.13) of an object made of iron, oxidation takes place and that spot behaves as anode and we can write the reaction

$$\text{Anode: } 2\,Fe(s) \longrightarrow 2\,Fe^{2+} + 4\,e^- \qquad E^{\ominus}_{(Fe^{2+}/Fe)} = -0.44\ V$$

Electrons released at anodic spot move through the metal and go to another spot on the metal and reduce oxygen in presence of H^+ (which is believed to be available from H_2CO_3 formed due to dissolution of carbon dioxide from air into water. Hydrogen ion in water may also be available due to dissolution of other acidic oxides from the atmosphere). This spot behaves as cathode with the reaction

$$\text{Cathode: } O_2(g) + 4\,H^+(aq) + 4\,e^- \longrightarrow 2\,H_2O\,(l) \qquad E^{\ominus}_{H^+|O_2|H_2O} = 1.23\ V$$

The overall reaction being:

$$2Fe(s) + O_2(g) + 4H^+(aq) \longrightarrow 2Fe^{2+}(aq) + 2\,H_2O\,(l) \qquad E^{\ominus}_{(cell)} = 1.67\ V$$

(annotations: 0, 0, +2, −2)

The ferrous ions are further oxidised by atmospheric oxygen to ferric ions which come out as rust in the form of hydrated ferric oxide ($Fe_2O_3 .\ x\,H_2O$) and with further production of hydrogen ions.

$Fe \rightarrow Fe^{+2} + 2e^-$

$Fe^{+2} + O_2 + 4H^+$

↓ +3

$Fe_2O_3 \cdot xH_2O$ → Ferric oxide

Brown col^r (Rust)

Qsd-1 Al^{+3}

1 mole of Al is deposited by X coulomb of electricity passing through aluminium nitrate solution. The number of moles of silver deposited by X coulomb of electricity from silver nitrate solution is-

$AgNO_3$

(A) 3

(B) 4

(C) 2

(D) 1

No. of gram Eq. of Al = No. of gram Eq. of Ag

$$n_{Al} \times (\text{mole})_{Al} = n_{Ag} \times (\text{mole})_{Ag}$$

$$3 \times 1 = 1 \times (\text{mole})_{Ag}$$

Mole of Ag = 3 mole

Qsd-2

Cu^{+2}

A currnet of 2.6 ampere is passed through $CuSO_4$ solution for 6 minutes 20 seconds. The amount of Cu deposited is (At. wt. of Cu = 63.5, Faraday = 96500 C) -

t = second

(A) 6.35 g

(B) 0.635 g

(C) 0.325 g ✓

(D) 3.175 g

$$\eta \times \text{No. of mole} = \frac{q}{96500} = i \times t$$

$$2 \times \left(\frac{w}{63.5}\right) = \frac{2.6 \times 380}{96500}$$

$$w = \frac{2.6 \times 380 \times 63.5}{2 \times 96500} = 0.325 \text{ gram}$$

$6 \times 60 = 360$ sec
$+ 20$ sec
$= 380$ sec

$\frac{?}{2}$

Q1

Which of the following solutions has the highest equivalent conductance?

(A) 0.01M NaCl → $n = 1$

(B) 0.050 M NaCl

(C) ✓ 0.005M NaCl

(D) 0.02M NaCl

Sorry

$$\lambda_e = \frac{K \times 10^3}{N}$$

$$N = M \times n = M \times 1 = M$$

$$\lambda_e \propto \frac{1}{N}$$

Q2

The specific conductance of a solution is 0.3568 ohm^{-1}. When placed in a cell the conductance is 0.0268 ohm^{-1}. The cell constant is-

(A) 1.331 cm^{-1}

(B) 13.31 cm^{-1} ✓

(C) 0.665 cm^{-1}

(D) 6.65 cm^{-1}

κ — $S \times cm^{-1}$; C

$$\kappa = C \times \left(\frac{l}{A}\right)$$

$$\left(\frac{l}{A}\right) = \frac{\kappa}{C} = \frac{0.3568}{0.0268} = 13.3\ cm^{-1}$$

Q5

The best conductor of electricity is in 1M solution of-

(+5Rs →)

(−5Rs →)

(A) CH_3COOH → W.A

(B) H_2SO_4 → S.A

(C) H_3PO_4 → W.A

(D) Boric acid → W.A

Cond^c → Strong electrolyte >> weak electrolyte

Strong Acid >> weak acid

Q7

The standard electrode potential of Zn, Ag and Cu are –0.76, 0.80 and 0.34 volt respectively; then -

(A) Ag can oxidise Zn and Cu

(B) Ag can reduce Zn^{2+} and Cu^{2+}

(C) Zn can reduce Ag^{+} and Cu^{2+}

(D) Cu can oxidise Zn and Ag

Q8

Consider following half-cell reaction-

I. $A + e^- \rightarrow A^-$ $E° = 0.96\ V$

II. $B^- + e^- \rightarrow B^{2-}$ $E° = -0.12\ V$

III. $C^+ + e^- \rightarrow C$ $E° = +0.18\ V$

IV. $D^{2+} + 2e^- \rightarrow D$ $E° = -1.12\ V$

What combination of two half-cells would result in a cell with the largest potential?

(A) I and II

(B) I and III

(C) I and IV

(D) II and IV

$(E_{cell})_{max} = (E^0_{RP})_C - (E^0_{RP})_A$

highest lowesh

Q10

At equilibrium -

$\Delta G = 0$ $\Delta G = -nFE_{cell}$

$E_{cell} = 0$

(A) $E^\circ_{cell} = 0$, $DG^\circ = 0$

(B) $E_{cell} = 0$, $\Delta G = 0$

(C) both are correct

(D) none is correct

Q11

When sodium chloride solution is electrolysed, the gas that is liberated at the cathode is-

Cathode → Red^n = Cation → Na^+, H^+ ⇒ $2H^+ + 2e^- \rightarrow H_2(g)\uparrow$

(A) Oxygen

(B) Hydrogen

(C) Chlorine

(D) Air

SANKALP NEET VEDANTU

Q12

The molar conductances of HCl, NaCl and CH_3COONa are 426, 126 and 91 $\Omega^{-1}\ cm^2\ mol^{-1}$ respectively. The molar conductance for CH_3COOH is-

(A) 561 $\Omega^{-1}\ cm^2\ mol^{-1}$

(B) 391 $\Omega^{-1}\ cm^2\ mol^{-1}$

(C) 261 $\Omega^{-1}\ cm^2\ mol^{-1}$

(D) 612 $\Omega^{-1}\ cm^2\ mol^{-1}$

$(91+426)-126$

$= 91+300$

$= 391$

Q13

For a reaction $A(s) + 2B^+ \longrightarrow A^{2+} + 2B$ K_C has been found to be 10^{12}. The E^0_{cell} is-

(A) 0.354 V

(B) 0.708 V

(C) 0.0098 V

(D) 1.36 V

$$E^0_{cell} = +\frac{0.0591}{n}\log K_{eq}$$

$$= +\frac{0.0591}{2}\log 10^{12}$$

$$= +\frac{0.0591}{2}\times 12 \times \log 10$$

$$= 0.3446 \simeq 0.35$$

Q15

Which of the following statements about the spontaneous reactions occuring in a galvanic cell is always true ?

NEET-2025

(A) $E^\circ_{cell} > 0$, $\Delta G^\circ < 0$, and $Q < K_{eq}$

(B) $E^\circ_{cell} > 0$, $\Delta G^\circ < 0$, and $Q > K_{eq}$

(C) $E^\circ_{cell} > 0$, $\Delta G^\circ > 0$, and $Q > K_{eq}$

(D) $E^\circ_{cell} > 0$, $\Delta G < 0$, and $Q < K_{eq}$

$\Delta G = -ve$, $E_{cell} = +ve$

$\Delta G < 0$

$E_{cell} > 0$

$\frac{Q_c}{K_{eq}} < 1$

$Q_c < K_{eq}$

$\Delta G^\circ = +\frac{0.0591}{n} \log K_{eq}$

$\Delta G = \Delta G^\circ + RT \ln Q_c$

$\Delta G = RT \ln \frac{Q_c}{K_{eq}}$ — Equilibrium, Electrochemistry

ΔG → −ve

$\log x = -ve \rightarrow x < 1$

Q18

Given

$Ag^+ / Ag \rightarrow +0.80\ V$

$Cu^{2+} / Cu \rightarrow +0.34\ V$

$Co^{2+} / Co \rightarrow -0.28\ V$

$Zn^{2+} / Zn \rightarrow -0.76\ V$

The most reactive metal which displaces other metals from their salt solution is :

A) Ag

B) Cu

C) Co

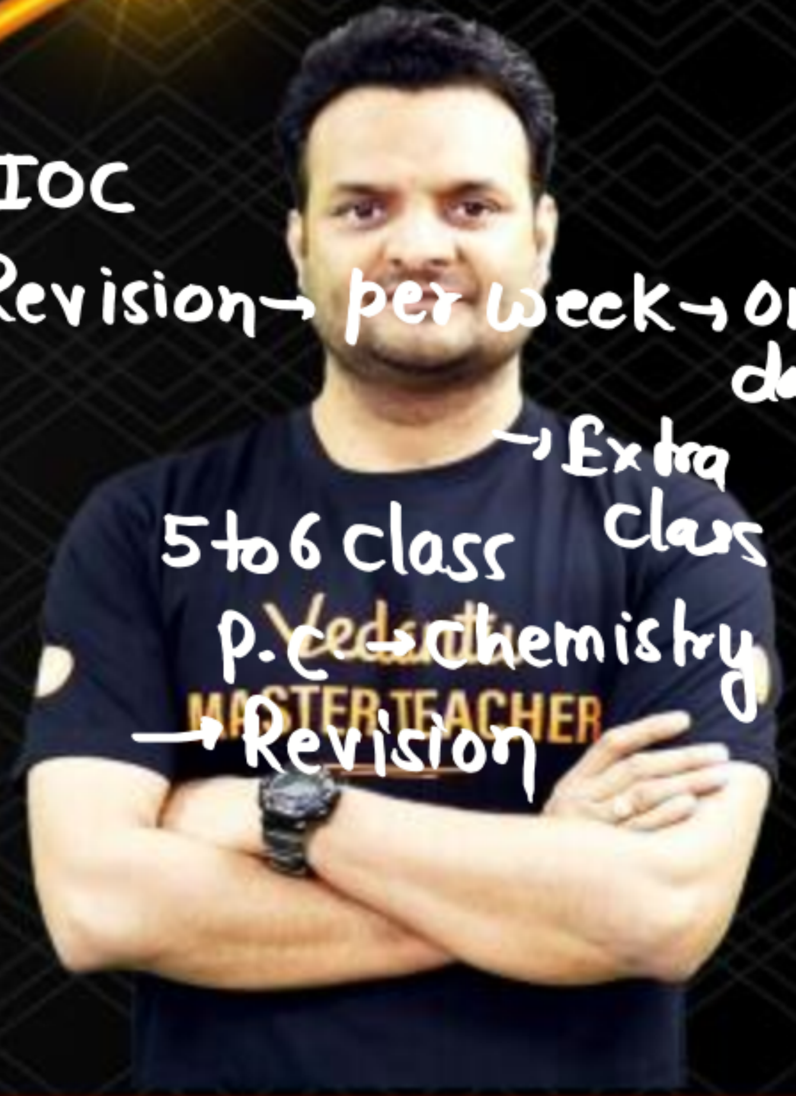
D) Zn

MANTHAN NEET 2025

CHEMISTRY

ATOMIC STRUCUTURE

Lecture-01



PC → IOC

PC → Revision → per week → one day

→ Extra Class

5 to 6 Class

P.C → Chemistry

→ Revision

Sarvesh Sir

$$\text{Efficiency of fuel cell} = \frac{\Delta G}{\Delta H} \times 100$$ → Right

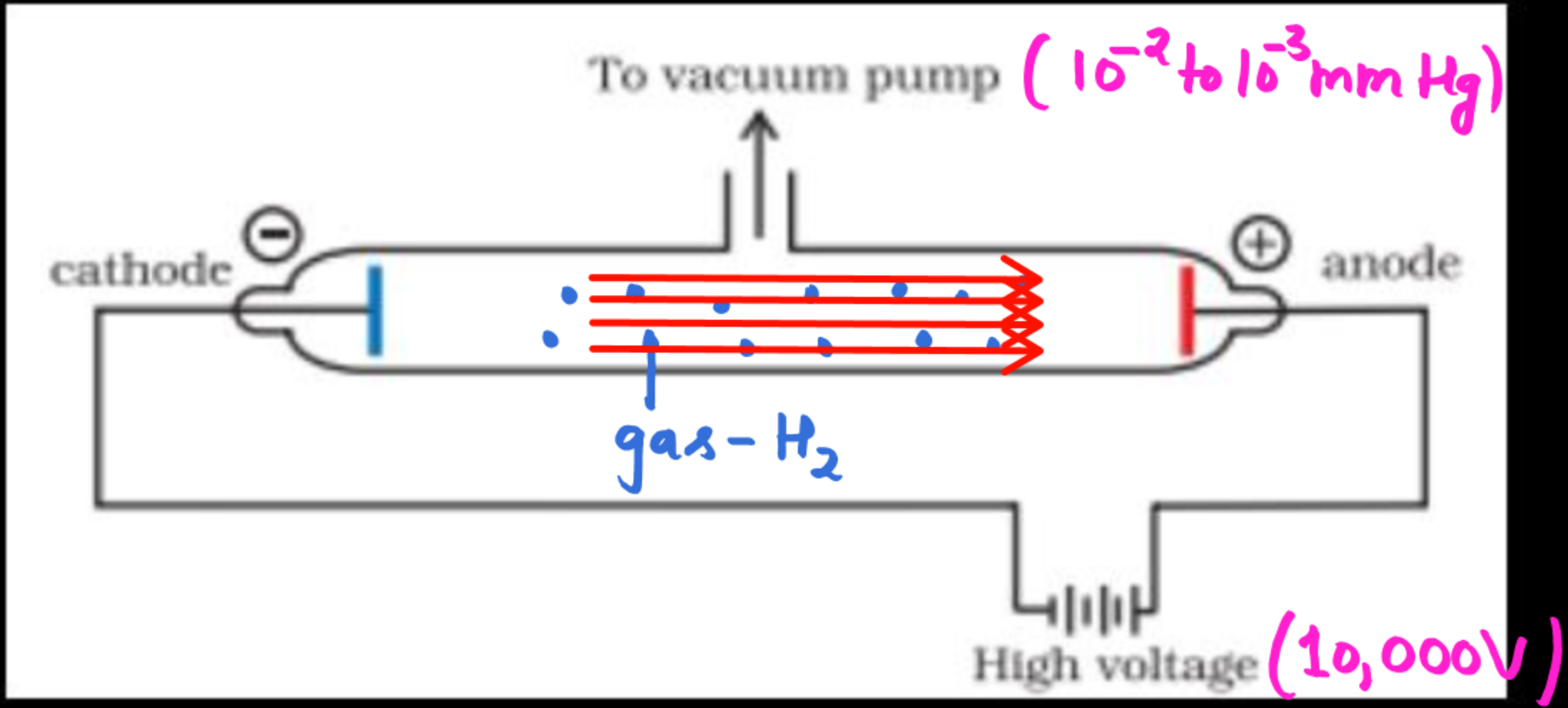
$$\text{efficiency of fuel cell} = \frac{-nFE_{cell}}{\Delta H} \times 100$$

Discovery of electron

$H_2 \rightarrow H \text{-}\!\!\!\!\!\wr\; H \rightarrow H + H$

$H \longrightarrow H^+ + e^-$

e^- ↓ Collection of negative particle (electron) = Cathode rays



discharge tube = Gas ionise

* Cathode rays = Collection of negative particle (electron)

* direction → Cathode → Anode

* having charge = negative = -1.6×10^{-19} C (Mulliken oil drop method)

* Fundamental particle = electron

H_2 gas → Cathode rays (e^-)

O_2 gas, He gas etc → Cathode rays (e^-)

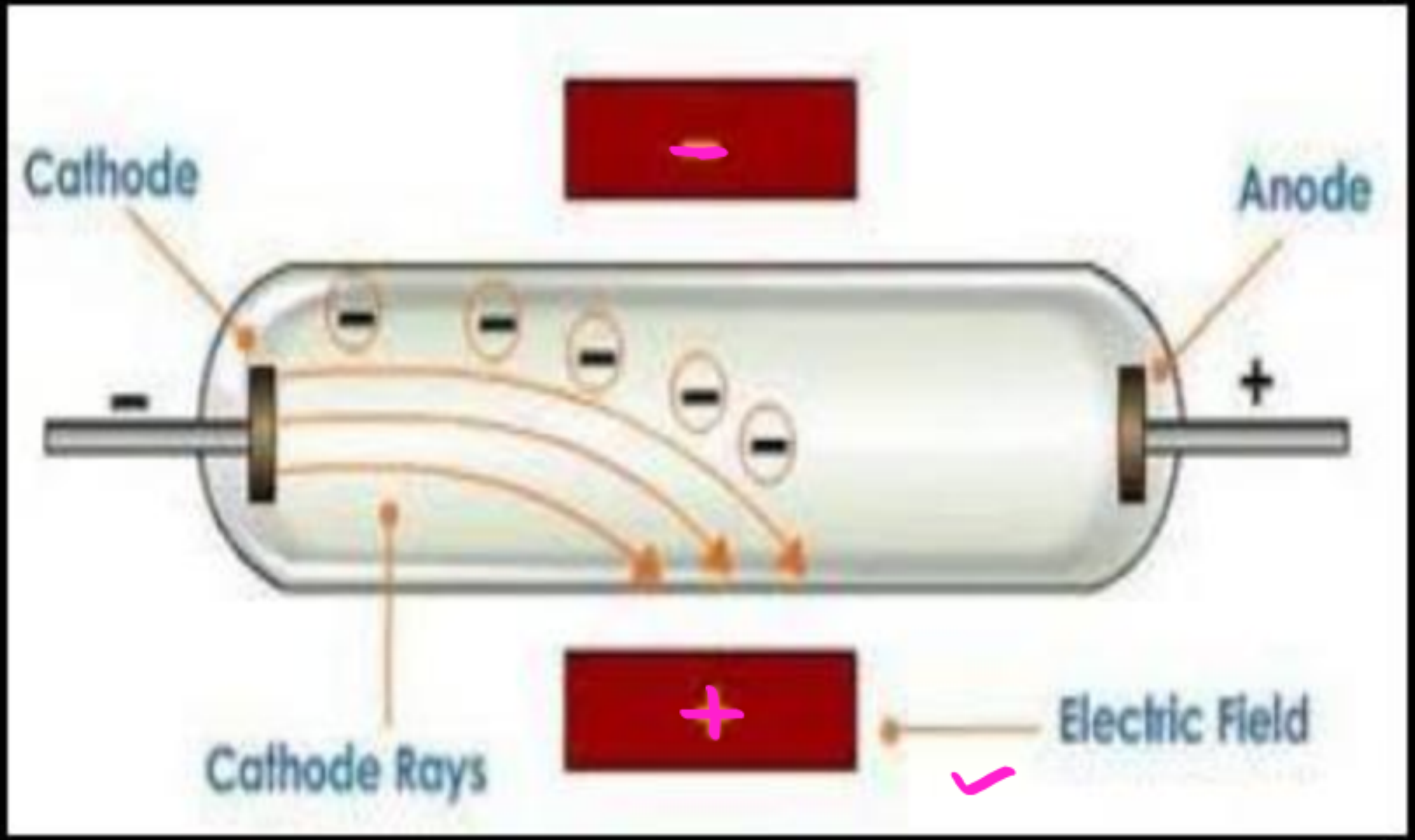
* Mass of e^- = 9.1×10^{-31} Kg

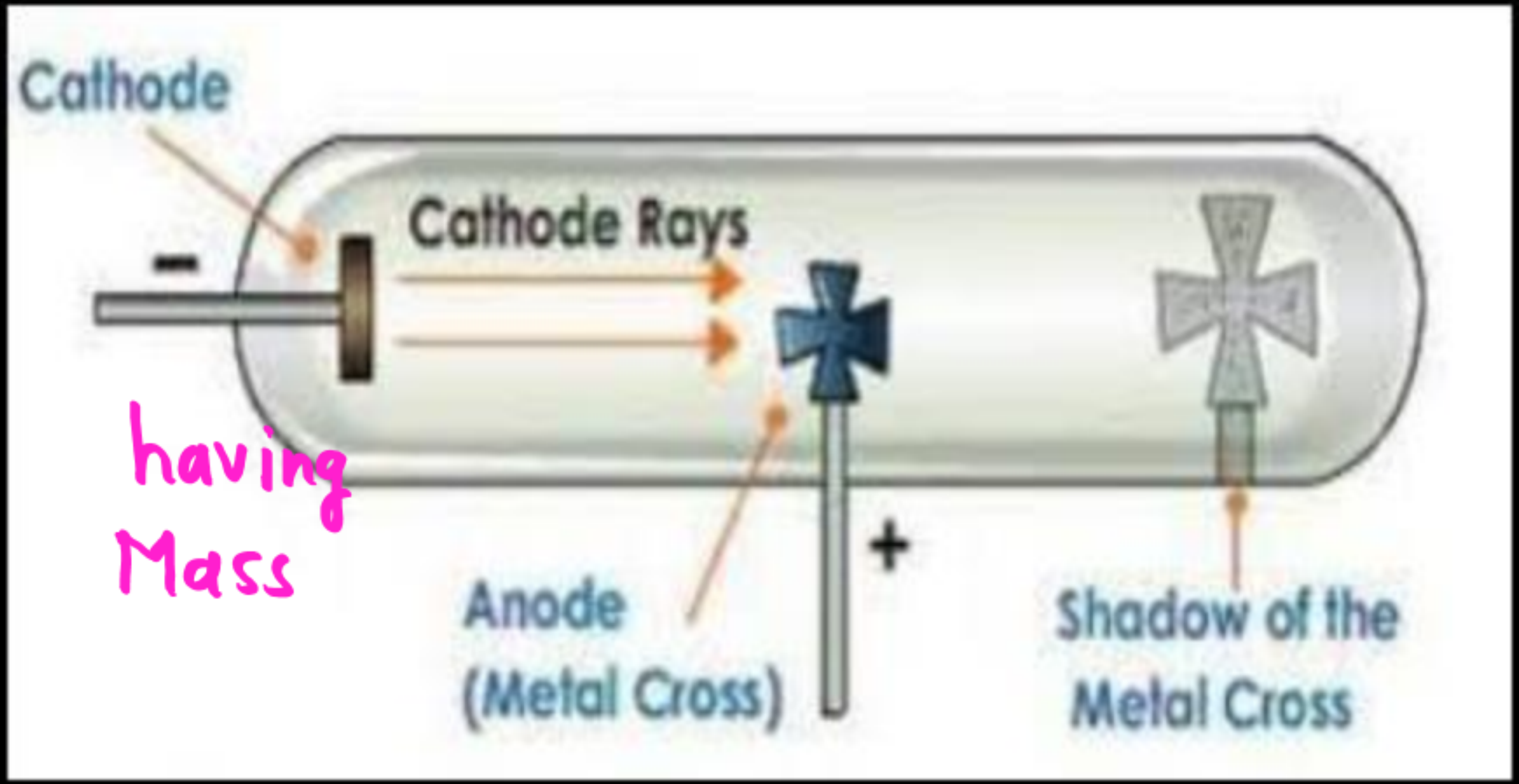
* Cathode rays = photographic effect (White → Black)

* Wheel → rotate kr deti hai

* electric field → +ve plate move

* Magnetic field → deflect +ve plate


Cathode
Anode
Cathode Rays
Electric Field


Cathode
Cathode Rays
having Mass
Anode
(Metal Cross)
Shadow of the
Metal Cross

$\frac{e}{m}$ ratio or specific charge or $\frac{\text{charge}}{\text{mass}}$ ratio

$$\frac{e}{m} \text{ ratio of particle} = \frac{\text{Charge of particle}}{\text{Mass of particle}}$$

$$10^{-19+31}$$

$$10^{+12}$$

$$\frac{e}{m} \text{ ratio of electron} = \frac{\cancel{1.6} \times 10^{-19}\, C}{\cancel{9.1} \times 10^{-31}\, kg} \quad (0.175) = 1.7 \times 10^{11} \frac{C}{kg}$$

$$\frac{e}{m} \text{ ratio} \propto \text{charge}, \quad \frac{e}{m} \propto \frac{1}{\text{mass}}$$

Q → H^+ → $\frac{e}{m}$ ratio $= \frac{1 \times 1.6 \times 10^{-19}\,C}{1.6 \times 10^{-27}\,kg} =$

He^{+2} → α-particle

$\frac{e}{m} = \frac{2 \times 1.6 \times 10^{-19}\,C}{4 \times 1.6 \times 10^{-27}\,kg}$

${}_{2}He^{(4)}$ → (4) $= 4 \times 1.6 \times 10^{-27}\,kg$

4 → Mass Number

Calculate $\frac{e}{m}$ ratio of Li^{+2}

${}_{3}Li^{(9)}$

a) $\frac{2}{9}\frac{C}{kg}$

b) $\frac{2 \times 1.6 \times 10^{-19}\,C}{9 \times 1.6 \times 10^{-27}\,kg}$ ✓

c) NONE

$Li^{+2} \Rightarrow \frac{2 \times 1.6 \times 10^{-19}\,C}{9 \times 1.6 \times 10^{-27}\,kg}$

Note $\frac{e}{m}$ ratio value $\propto \frac{1}{\text{Voltage of battery}}$

$\frac{e}{m}$ ratio of cathode ray does not depend upon (1) nature of gas ✓

(2) nature of electrode

$\uparrow m_v = \frac{m_{rest}}{\left(\sqrt{1-\left(\frac{v\uparrow}{c}\right)^2}\right)\downarrow}$

$\downarrow \frac{e}{m}$ ratio $\propto \frac{1}{(\text{mass})_u \uparrow}$

$\rightarrow k = \frac{1}{2}mu^2$

Q $\frac{e}{m}$ ratio of cathode ray of which gas is higher.

H_2 gas, N_2 gas

a) H_2 b) N_2

c) equal for both gas ✓ d) Can not say

Anode Rays (discovery of proton)

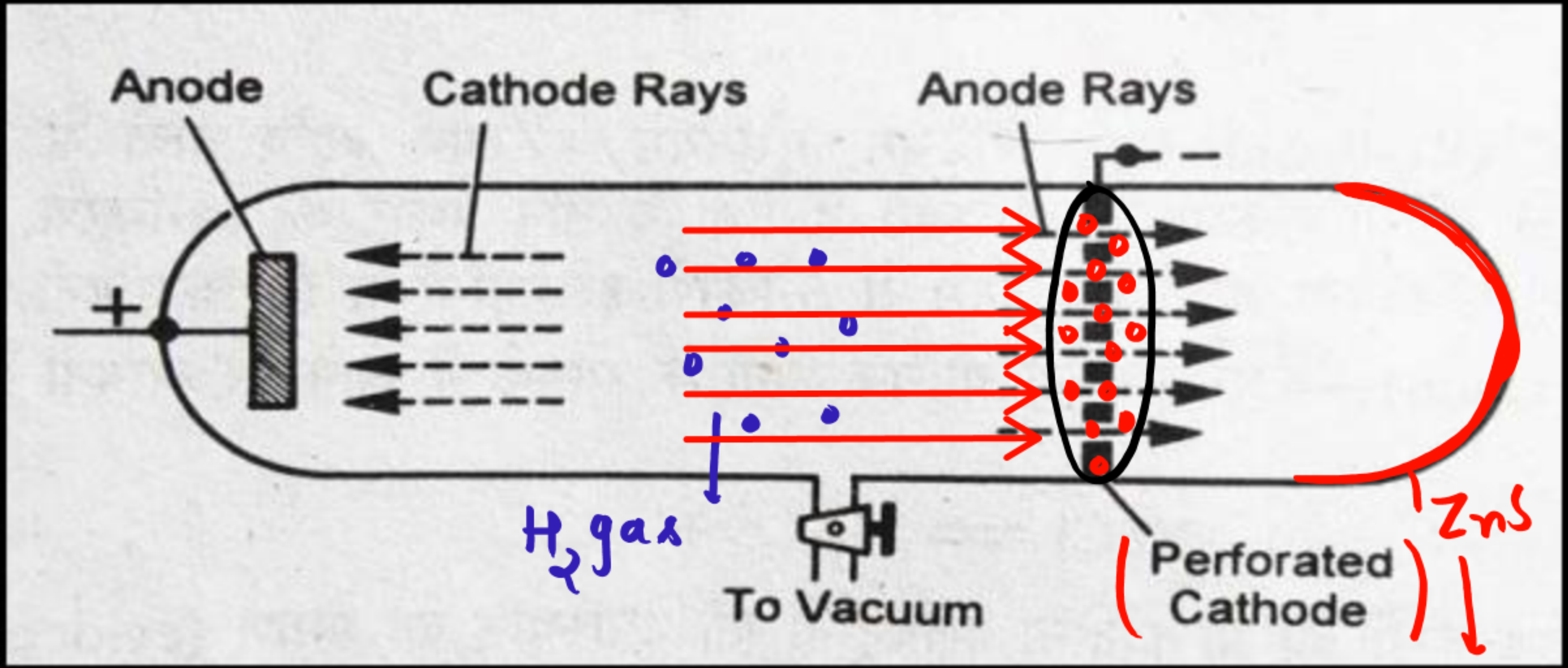
$H_2 \Rightarrow H - H \longrightarrow H + H$

$H \longrightarrow H^+ + e^-$

Collectn of e^- = Cathode ray → +ve plate (Anode)

Collection of Cation is known as → Anode ray or Canal rays

$H_2 \rightarrow H^+ \rightarrow$ proton



Flouro-scence

$He \rightarrow He^{+2} + 2e^-$

He^{+2} → Anode ray

$2e^-$ → Cathode rays

$N_2 \rightarrow N + N$

$N \rightarrow N^{+3} + 3e^-$

N^{+3} → Anode rays

CSD

Cathode rays	Anode rays
→ Collection of e^-	Collection of Cation of gas ($H_2 \rightarrow H^+$, $He \rightarrow He^{+2}$)
→ St. travell, photographic plate	→ St. travell, photographic plate
→ effect, wheel → rotate	→ effect, wheel → rotate
→ Charge = $-1.6\times10^{-19}C$	Charge = $+1.6\times10^{-19}C$
→ mass = $9.1\times10^{-31}kg$	mass of proton = $1.67\times10^{-27}kg$
$\frac{e}{m}$ ratio of e^- or Cathode ray = $1.7\times10^{+11}\frac{C}{kg}$	$\frac{e}{m}$ ratio of proton = $\frac{1.6\times10^{-19}}{1.67\times10^{-27}} \approx 10^{8}\frac{C}{kg}$

CSP

Cathode ray	Anode ray
$\frac{e}{m}$ ratio → independent nature of gas	$\frac{e}{m}$ ratio of Anode ray → depend in nature of gas
$\frac{e}{m}$ ratio $\propto \frac{1}{\text{Voltage}}$	$\frac{e}{m}$ ratio $\propto \frac{1}{\text{Voltage}}$

<u>neutron</u> → $_0n^1$

charge = zero

Mass = 1.675×10^{-27} Kg

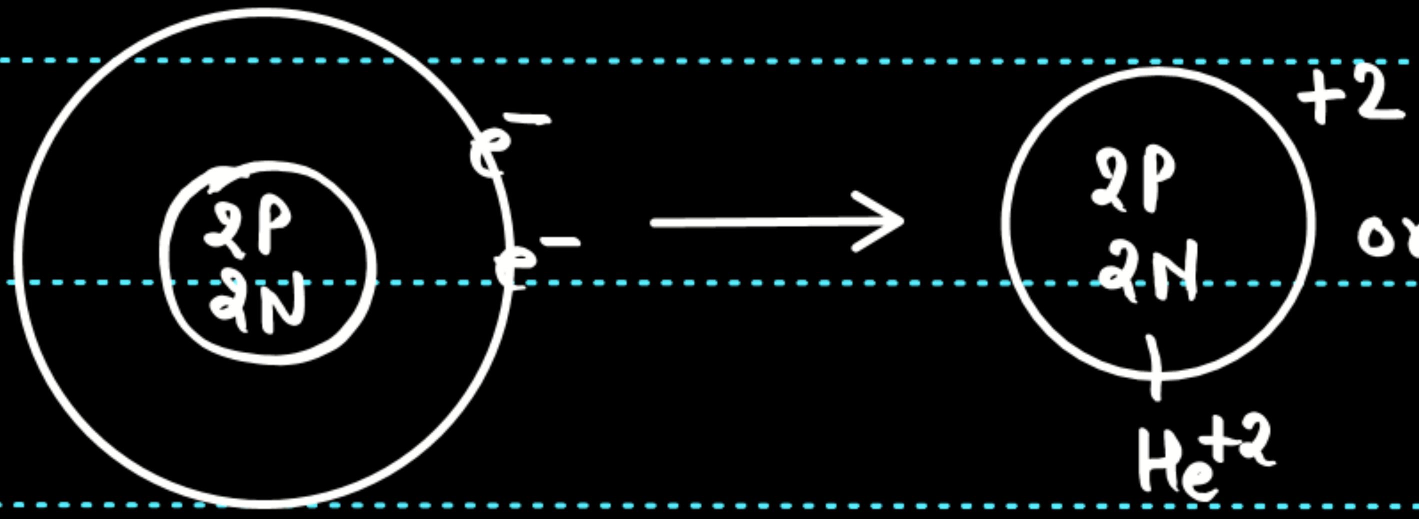
Mass of n^0 = Mass of proton

$\frac{e}{m}$ ratio of neutron $= \frac{0\ C}{1.6 \times 10^{-27}\ Kg} =$ zero

e^-, p^+ & n^0 = fundamental particle

Discovery of neutron

He-atom = $_2He^4 \rightarrow p = 2, e = 2, n = A - Z = 4 - 2$



or α-particle = $_2He^4$

He-atom = $_2He^4$

$$_4Be^9 + {}_2He^4 \longrightarrow {}_6C^{12} + {}_0n^1$$

($_2He^4$: α-particle; $_0n^1$: neutron)

particles	Charge	Mass	Mass in amu
electron (e^-)	1.6×10^{-19} C or -1	9.1×10^{-31} kg or $\frac{1}{1837}$ mass of H-atom	$\frac{9.1 \times 10^{-31}}{1.66 \times 10^{-27}}$ amu
proton (p^+)	1.6×10^{-19} C or $+1$	1.67×10^{-27} kg or 1	$\frac{1.67 \times 10^{-27}\ kg}{1.66 \times 10^{-27}\ kg}$ amu
neutron (n^0)	zero or 0	1.675×10^{-27} kg or 1	
α-particle ($_2He^4$) (He^{+2})	$2 \times 1.6 \times 10^{-19}$ C or $+2$	$4 \times 1.6 \times 10^{-27}$ kg or 4	

]

The increasing order (lowest first) for the values of e/m (charge/mass) for electron (e), proton (p), neutron (n) and alpha particle (α) is ______.

(A) e, p, n, α

(B) n, p, e, α

(C) n, p, α, e

(D) n, α, p, e

$n^0 < \alpha < p^+ < e$

$_2He^{+2}$

	e	p^+	n^0	α
e ⟶	1	1	0	2
m ⟶	$\frac{1}{1837}$	1	1	4
$\frac{e}{m}$ ⟶	$\frac{1}{\frac{1}{1837}} = 1837$	$\frac{1}{1} = 1$	$\frac{0}{1} = 0$	$\frac{2}{4} = \frac{1}{2}$

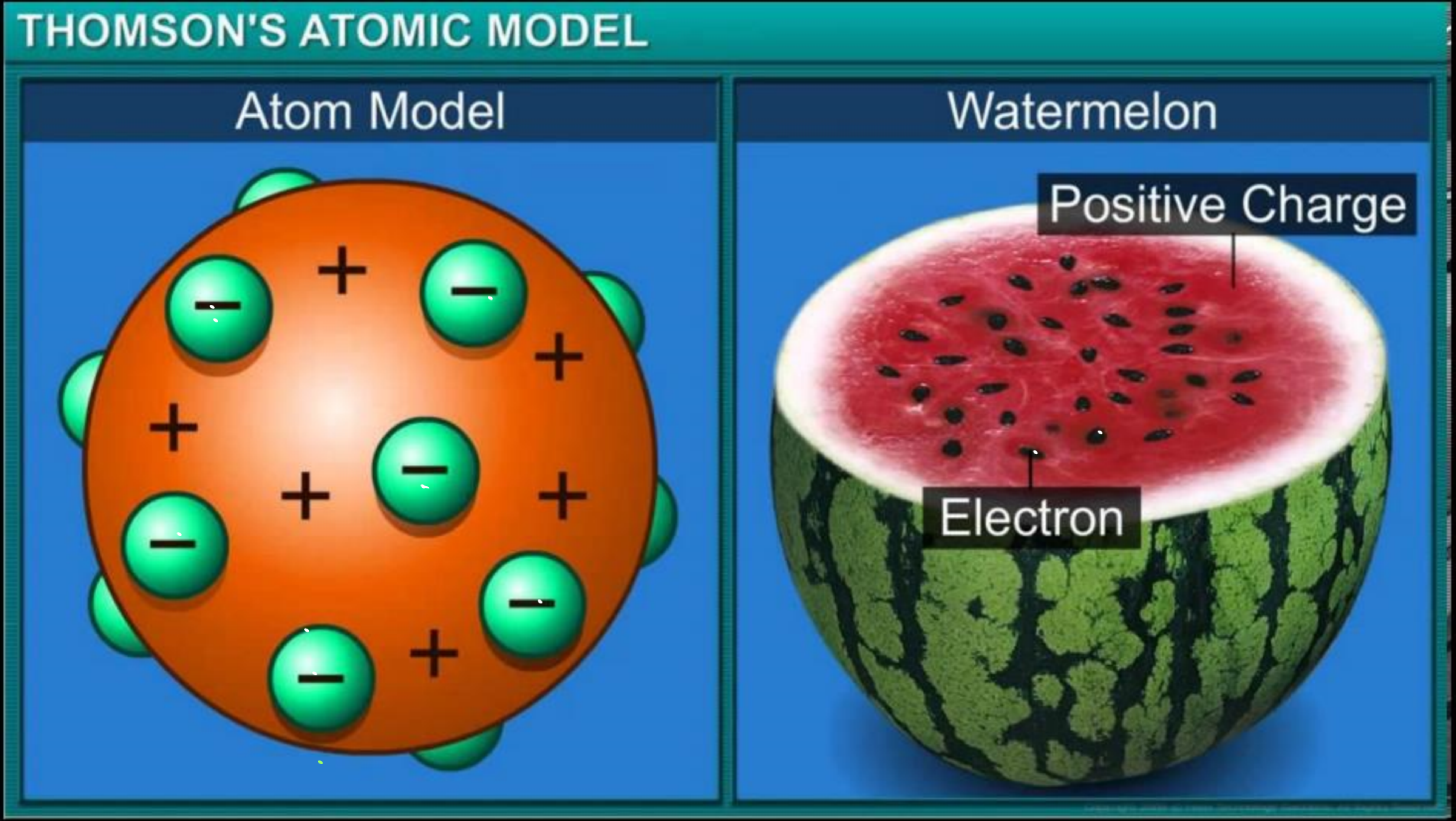
Q→ Select the highest $\frac{e}{m}$ ratio particle in given example

a) H^+ $({}_1H^1)$ → $+1/1 = 1$

b) He^{+2} $({}_2He^4)$ → $+2/4 = \frac{1}{2}$

c) Be^{+3} $({}_4Be^9)$ → $+3/9 = \frac{1}{3}$

d) e → $1/\frac{1}{1837} = 1837$


THOMSON'S ATOMIC MODEL
Atom Model
Watermelon
Positive Charge
Electron

J.J. thamson Atomic model (1898-99)

neutron → discovery nahi hue thi (1932)

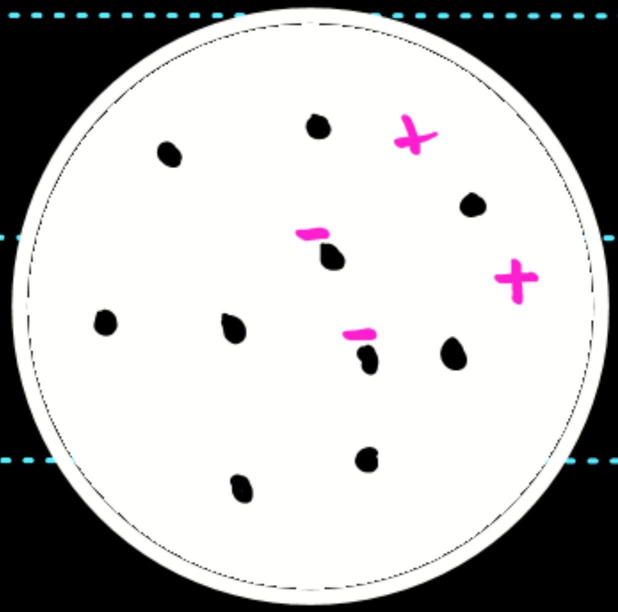
e^-, p^+ = subparticle

1) Atom → spherical

2) +ve charge (proton) = uniformully distributed in whole atom

3) e^- → embebbed in atom (cloud of p^+)

4) electro-static force = stable



Limitation

* Stability of atom does not explain

* water-melon model
* plum pudding model

MANTHAN NEET 2025

CHEMISTRY

ATOMIC STRUCUTURE

Lecture-02



Sarvesh Sir

5 month → best

Syllabus → 11th complete

P.C. ⇒ 11th + 12th Complete

→ Practice session

→ Revision

→ Chapterwise test

AITS → at HOME → 1499 Rs

6 - 180 | 180

6 - 200 | 200

5 - 11th - 3+2

5 - 12th - 3+2

— 200

(3) Physical chemistry

Qsd-1 highest $\frac{e}{m}$ ratio

$\frac{1}{\frac{1}{1837}}$

a) $n \rightarrow \frac{0}{1} = 0$

b) $H^{+} \rightarrow \frac{1}{1} = 1$

c) $He^{+2} = \frac{2}{4}$ $\quad {}_{2}He^{4}$

✓ d) $e = \frac{1}{\frac{1}{1837}} = 1837$

$\frac{\text{Charge}}{\text{mass}}$, highest, lowest, order

Qsd Arrange increasing order of Mass

e, p, α-particle

a) $\alpha < p < e$

b) $e < p < \alpha$

c) $e < \alpha < p$

d) NONE

$e = \frac{1}{1837} \times$ H-atom

$p = 1$ (H-atom)

$\alpha = 4$ $({}_2He^4)$

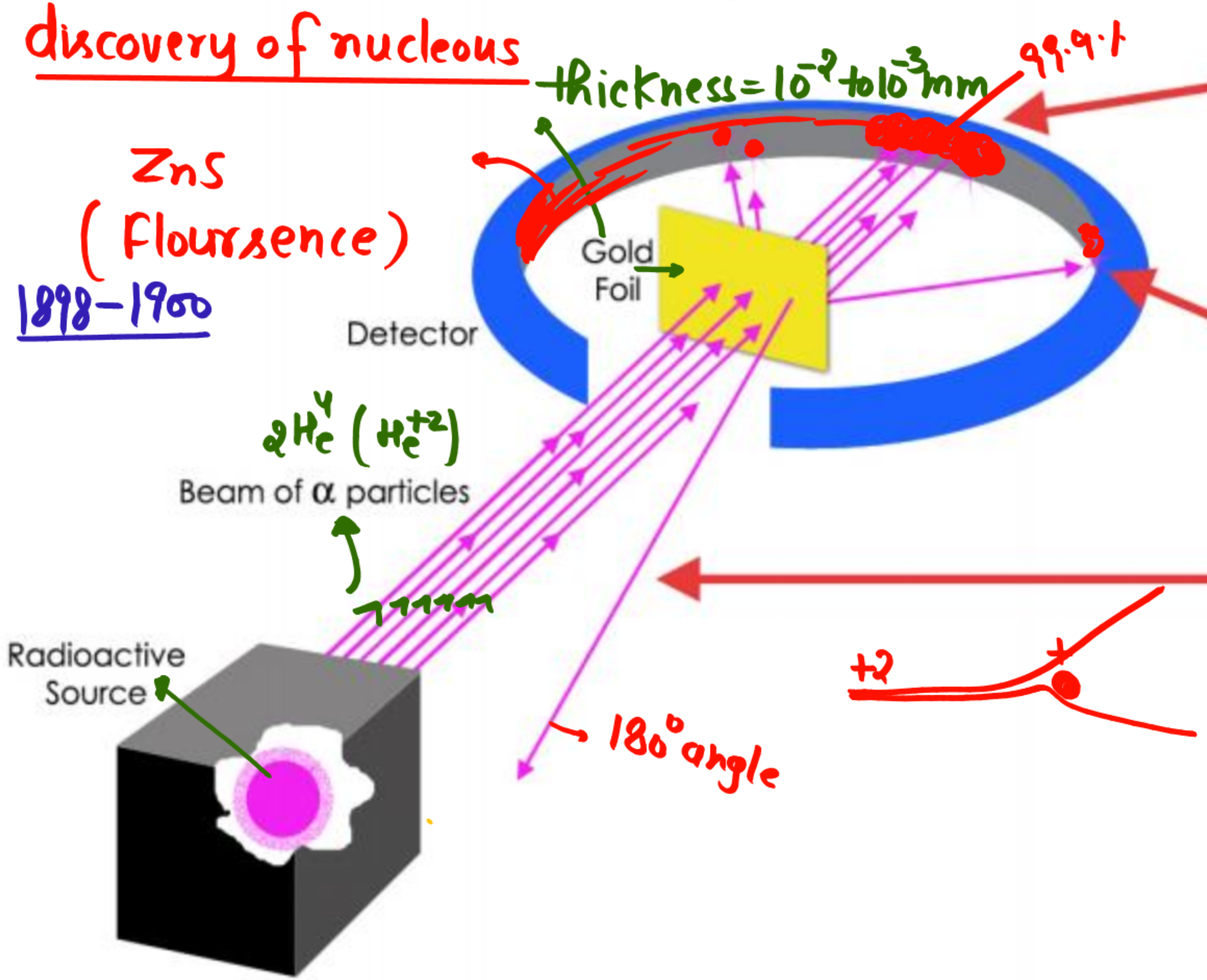
$m_\alpha = 4 \times$ H-atom

$\frac{?}{2}$

13:3

Rutherford's Gold Foil Experiment

discovery of nucleous

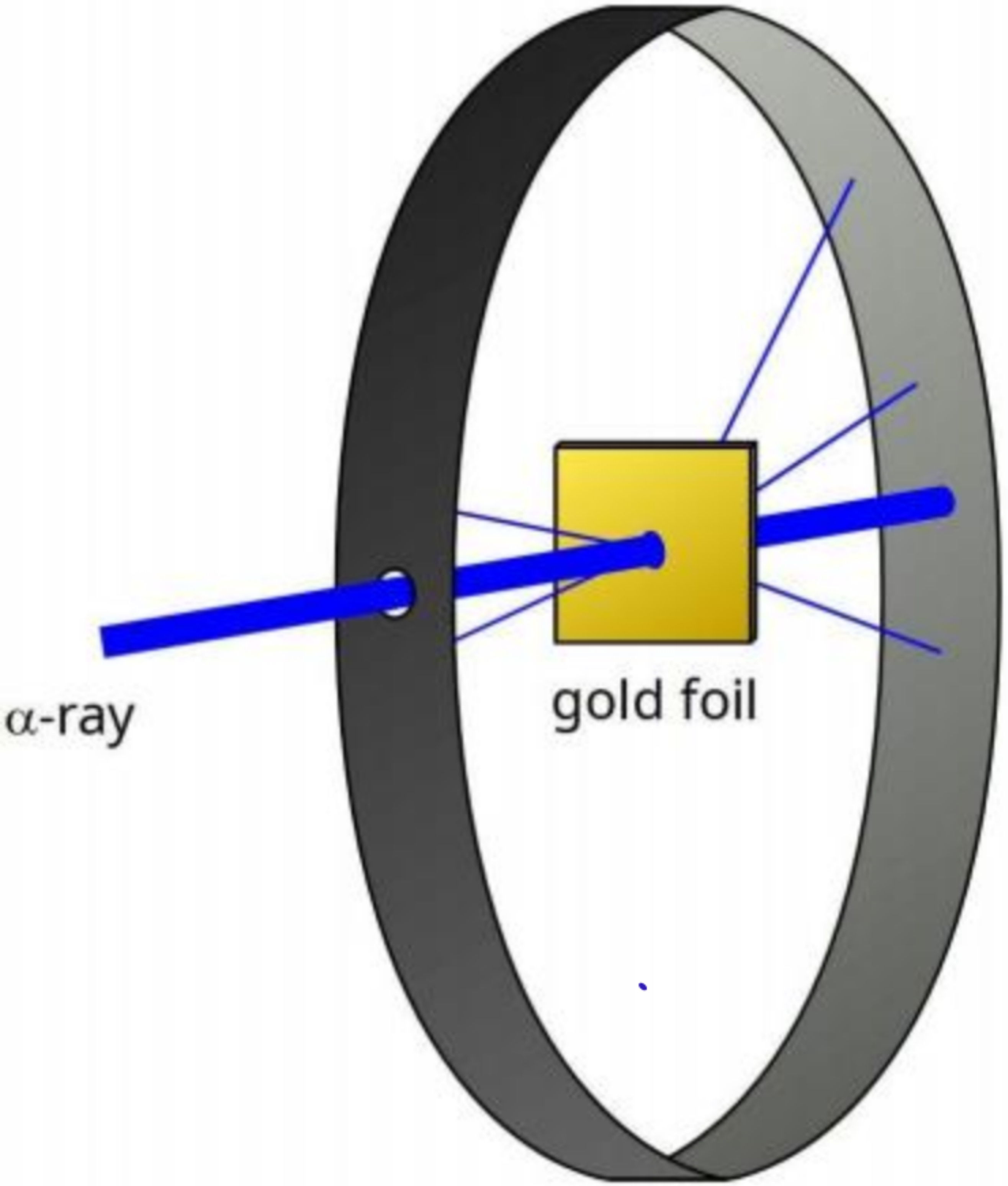


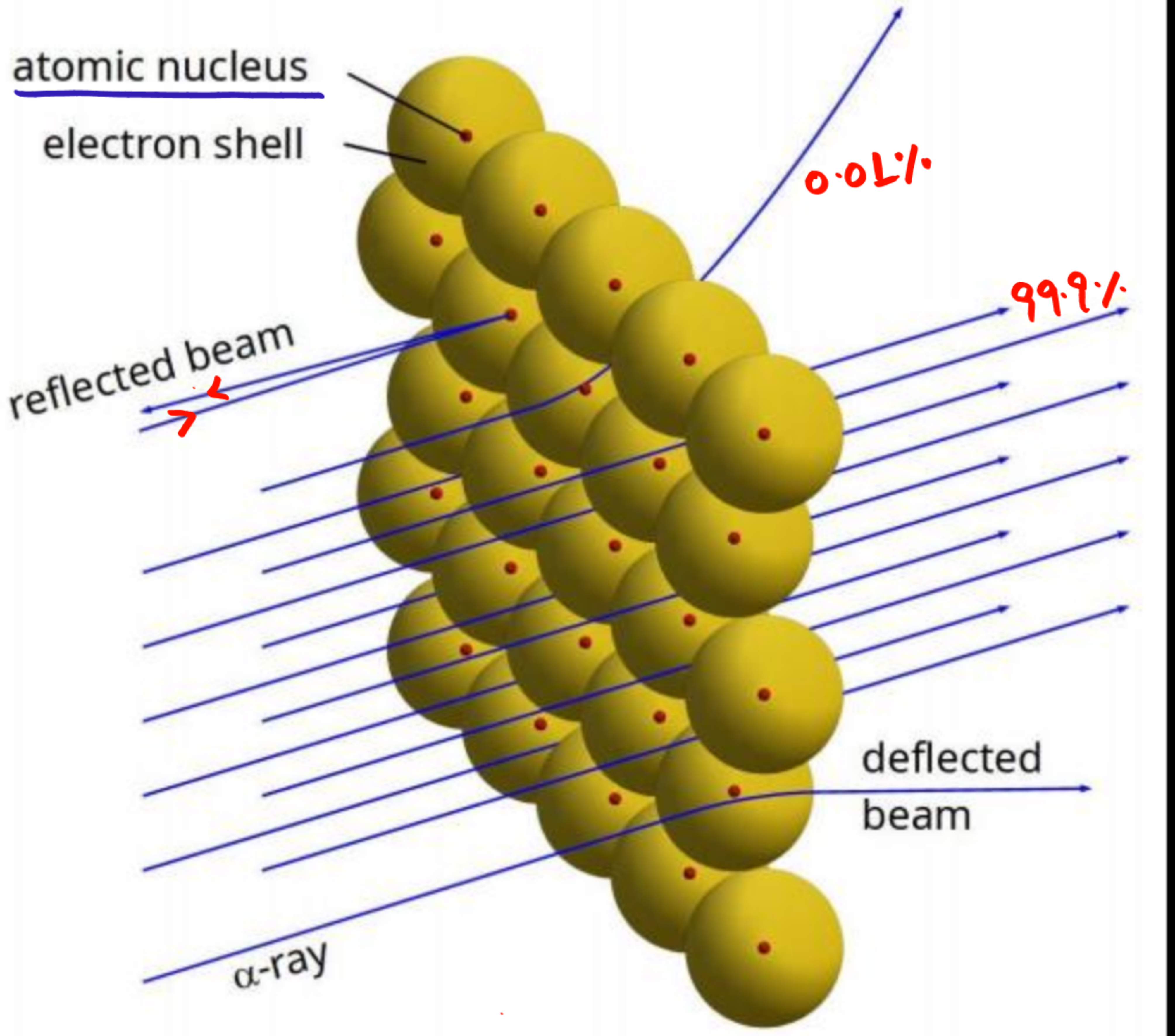
Observation	Interpretation
Most α particles travel through the foil undeflected	The atom is mostly empty space
Some α particles are deflected by small angles	The nucleus is positively charged, as is the α particle
20k → Koi 1 α Occasionally, an α particle travels back from the foil	The nucleus carries most of the atom's mass

Note → Tab tk → neutron ki discovery nahi hue the

1932

TEC-SCIENCE.COM





Rutherford Atomic model

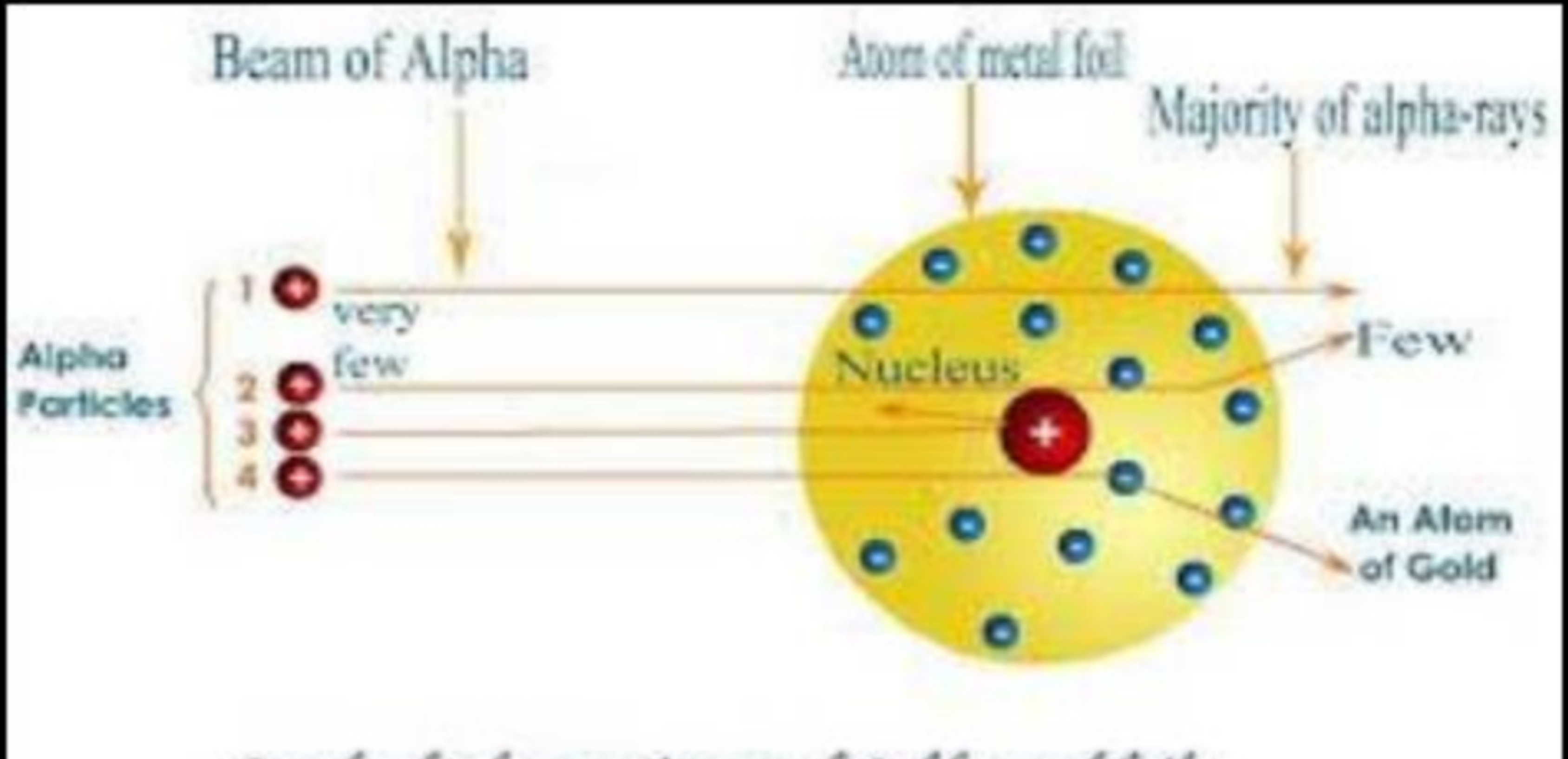
Atom - 2 part

1) Nucleous → proton → +ve
2) Extra nuclear part (empty space)
   → electron = -ve

→ $r_{Atom} \simeq 10^{-10}$ metre $= 10^{-8}$ cm

$r_N \simeq 10^{-15}$ metre $\simeq 10^{-13}$ cm

$r_A = 10^5 \times r_N$

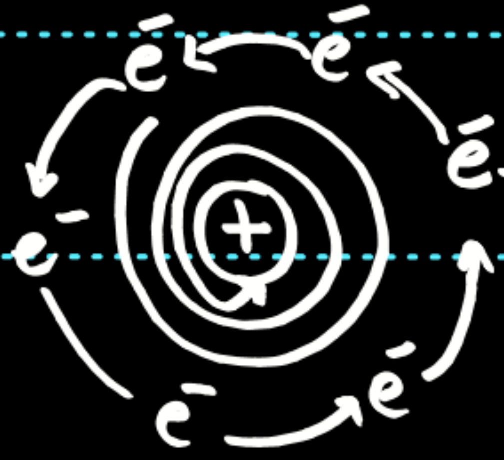


Rurtherfords experiment of Gold metal foil

→ electron → revolving in circular path of Extra nuclear part reason

→ Stability ⇒ sun + earth Concept

Limitation



e^- → energy release → energy Kam

[1981, 1M]

Rutherford's scattering experiment is related to the size of the ______.

(A) nucleus

(B) atom

(C) electron

(D) neutron

[1988, 1M]

1898–1900

The atomic nucleus contains ______.

(A) protons ✓✓

(B) neutrons ✗ (1932)

(C) electrons

(D) photons

[1981, M]

Rutherford's experiment on scattering of α-particles showed for the first time that the atom has ______.

(A) electrons

(B) protons

(C) nucleus

(D) neutrons

(1985, 1M)

The radius of an atomic nucleus is of the order of ______ 10^{-15} m ≈ 10^{-13} cm

(A) 10^{-18}

(B) 10^{-13} cm

(C) 10^{-15} cm

(D) 10^{-3} cm

[1984, 1M]

When alpha particles are sent through a thin metal foil, most of them go straight through the foil, because _____.

(A) alpha particle are much heavier than electrons

(B) alpha particle are positively charged

(C) most part of the atom is empty space

(D) alpha particles move with high veloctiy

[2002, 3M]

Rutherford's experiment, which established the nuclear model of the atom, used a beam of ______.

(A) β-particles, which impinged on a metal foil and got absorbed.

(B) γ-rays, which impinged on a metal foil and got scattered.

(C) helium atoms, which impinged on a metal foil and got scattered.

(D) helium nuclei, which impinged on a metal foil and got scared .

(He^{+2})

(1986, 1 M)

Rutherford's alpha particle scattering experiment eventually led to the conclusion that ______.

(A) mass and energy are related.

(B) electrons occupy space around the nucleus.

(C) neutrons are buried deep in the nucleus.

(D) the point of impact with matter can be precisely determined.

Dual nature of light (Sun light)

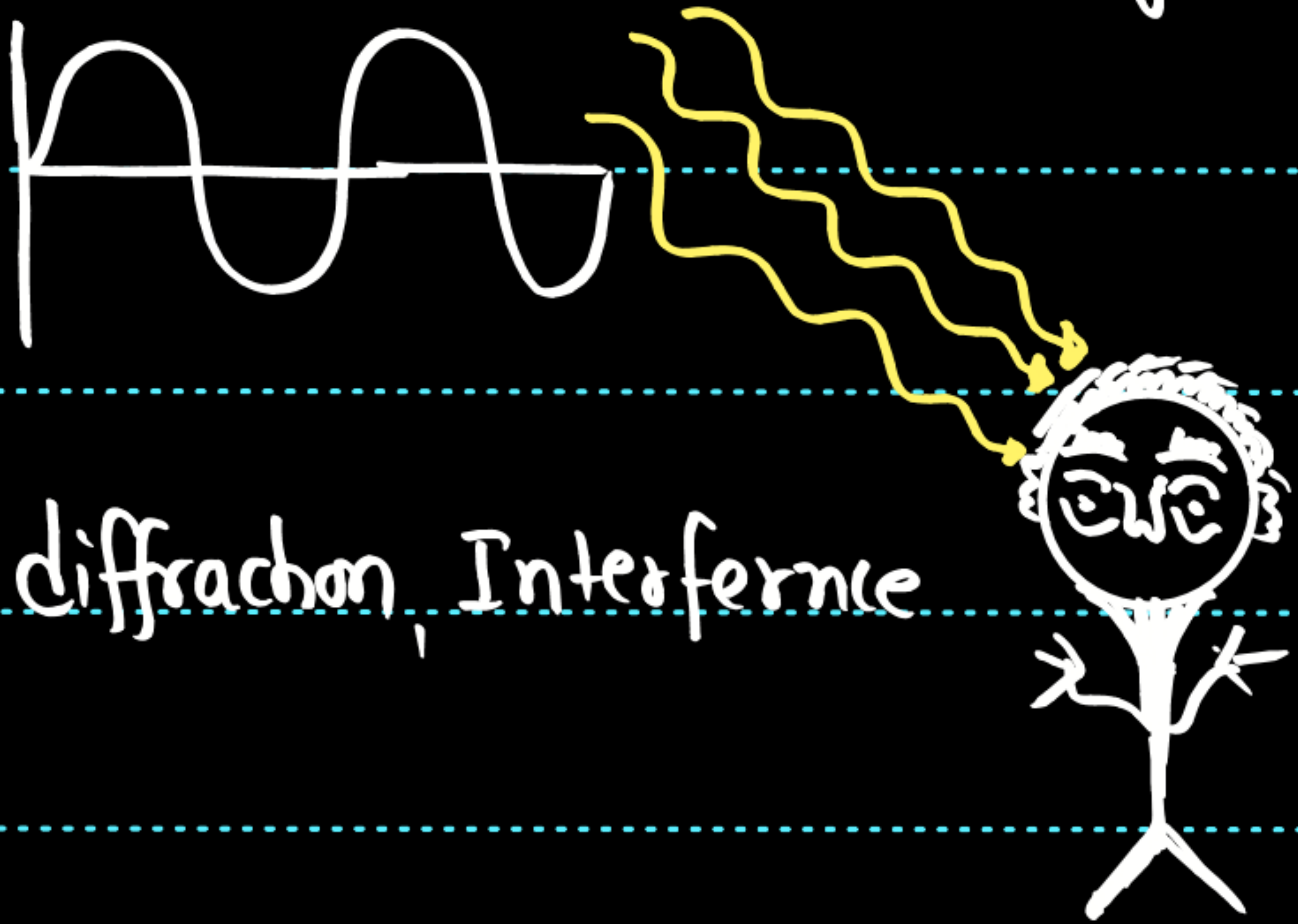
Practicle nature of light



→ small energy package
= quanta (in case of sunlight
quanta ⇒ photon)

→ Blackbody Radiation
Hydrogen spectrum, photoelectric effect

Wave nature of light



→ diffraction, Interfernce

Dual nature of light (Sun light)

Plank's Quantum theory

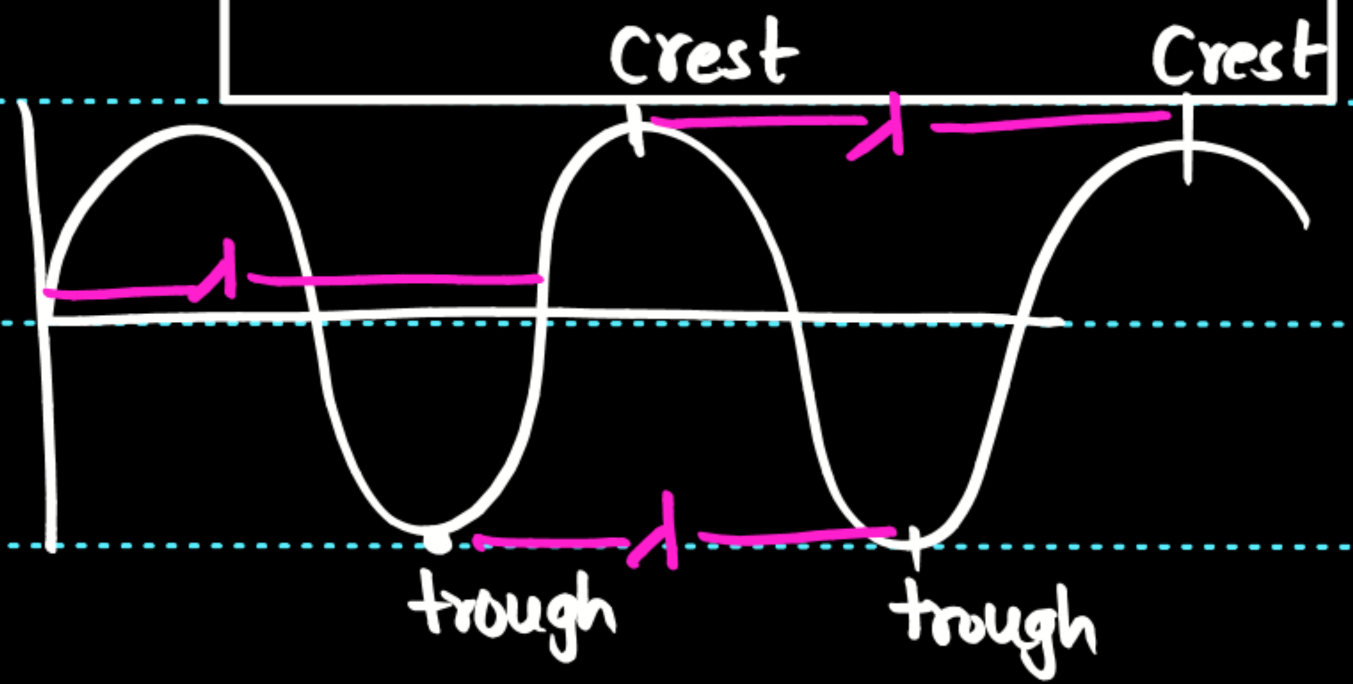
→ light → quanta (energy package)

→ $E \alpha \nu \Rightarrow E = h\nu = \frac{hc}{\lambda}$

h = plank's Const = 6.626×10^{-34} J x Sec

*** $E = n \times E_{min}$

$n = 1, 2, 3, 4, ---, n \neq 0$, fractional



Wavelength (λ) $1 A^0 = 10^{-10}$ m

$1 P^0 = 10^{-12}$ m

Dual nature of light (Sun light)

Suppose → $E_{min} = 2$ Joule ⇒ $E = n \times 2$

Possible E of quanta = 2, 4, 6, 8 - - - -

($E \neq 7, 9, 3$)

Frequancy (ν) = No. of wave pass through a point in one second

$$\nu = \frac{c}{\lambda}$$

c → speed of light = 3×10^8 m/sec

λ → wavelength

Wave number ($\bar{\nu}$)

$$\bar{\nu} = \frac{1}{\lambda}$$

Q → Minimum energy of photon release by sunlight is 3 Joule

Select possible value of energy of other photon of sunlight

a) 11 Joule ⓧ

b) 10 Joule ⓧ

c) 9 Joule ✓

d) All

$E = n \times E_{mini}$

$E = n \times 3$

$n = 1, 2, 3, 4, 5 - - -$

$\frac{E}{3}$

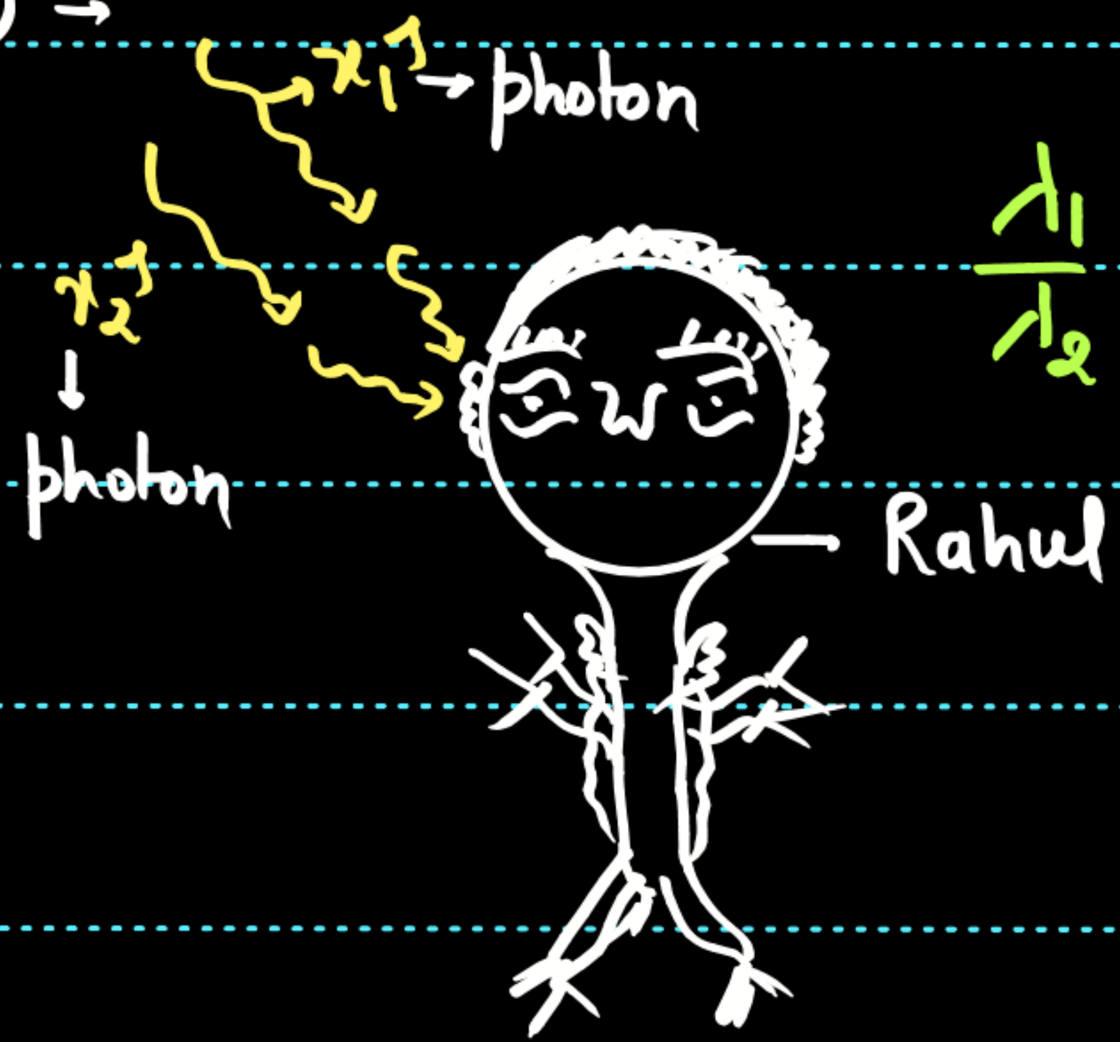
✗ a) 1150 J $\frac{1150}{3} = 383.33$

✓ b) 999 Joule $\frac{999}{3} = 333$

✓ c) 3471 Joule $\frac{3471}{3}$ 1157

d) All

$\phi \rightarrow$



$\frac{\lambda_1}{\lambda_2} = ?$

Select Correct ratio of wavelength of photon-1 and 2 respectively

a) $x_1 : x_2$

b) $x_2 : x_1$ ✓

c) $\frac{1}{x_1} : \frac{1}{x_2}$

d) $\frac{1}{x_2} : \frac{1}{x_1}$

$E = h\nu = \frac{hc}{\lambda} \Rightarrow x_1 = \frac{hc}{\lambda_1} \Rightarrow \frac{x_1}{x_2} = \frac{\lambda_2}{\lambda_1}$

$x_2 = \frac{hc}{\lambda_2}$

$\frac{\lambda_1}{\lambda_2} = \frac{x_2}{x_1}$

Example of particle nature of sunligth

1) Photo electric Effect

Sarvesh dixit csd official telegram

→ all chapter chapter Csd

→ U-tube → liquid solⁿ → 7·30 pm

→ Csd → → 2 shot Revision

→ lec notes

li

Mon-Fri = 7·30 pm

MANTHAN NEET 2025

CHEMISTRY

ATOMIC STRUCUTURE

Lecture-03



Sarvesh Sir

Q44. Which of the following is never true for cathode rays? [CBSE AIPMT 1994]

(a) They possess kinetic energy

(b) They are electromagnetic waves

(c) They produce heat

(d) They produce mechanical pressure

Qsd-2

Q8. Calculate the energy in joule corresponding to light of wavelength 45 nm (Planck's constant, $h = 6.63 \times 10^{-34}$ Js; speed of light $c = 3 \times 10^{8}$ ms^{-1}) **[CBSE AIPMT 2014]**

(a) 6.67×10^{15}

(b) 6.67×10^{11}

(c) 4.42×10^{-15}

(d) 4.42×10^{-18} ✓

$1\,nm = 10^{-9}\,m$

$\Delta E = h\nu = \frac{hc}{\lambda}$

$= \frac{6.63 \times 10^{-34}\,J \times sec \times 3 \times 10^{8}\,m/sec}{45 \times 10^{-9}\,m}$

$= \frac{66.3}{15} \times 10^{-18}$

$= 4.42 \times 10^{-18}\,J$

Qsd-3

Q13. The energies E_1 and E_2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelengths, i.e., L_1 and L_2 will be [CBSE AIPMT 2011]

(a) $L_1 = 2L_2$

(b) $L_1 = 4L = 2$

(c) $L_1 = \frac{1}{2} L_2$

(d) $L_1 = L_2$

$$E_1 = 25 = \frac{hc}{\lambda_1} \quad \text{--- (1)}$$

$$E_2 = 50 = \frac{hc}{\lambda_2} \quad \text{--- (2)}$$

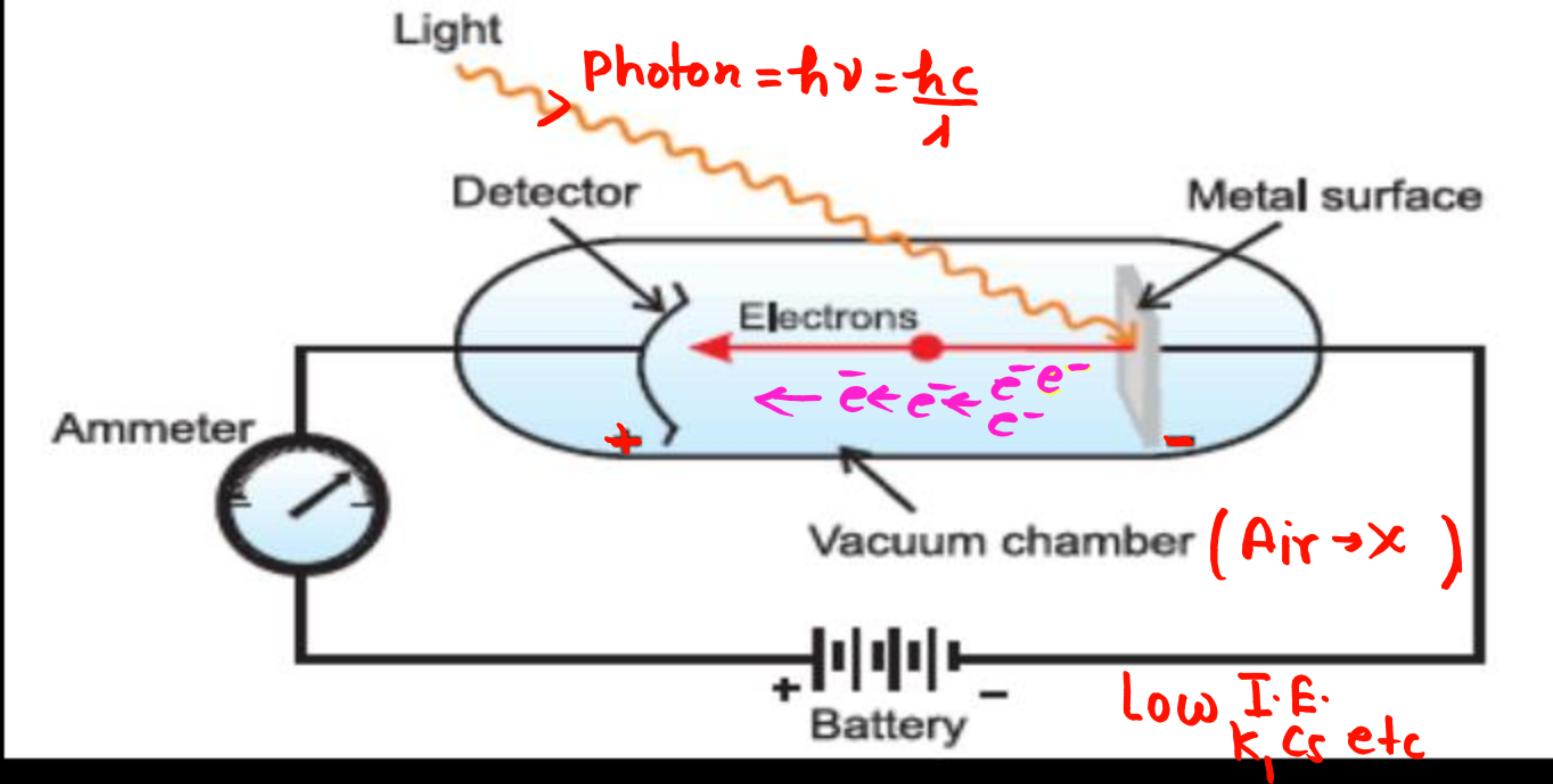
$$\frac{25}{50} = \frac{\lambda_2}{\lambda_1}$$

$$\lambda_1 = 2\lambda_2$$

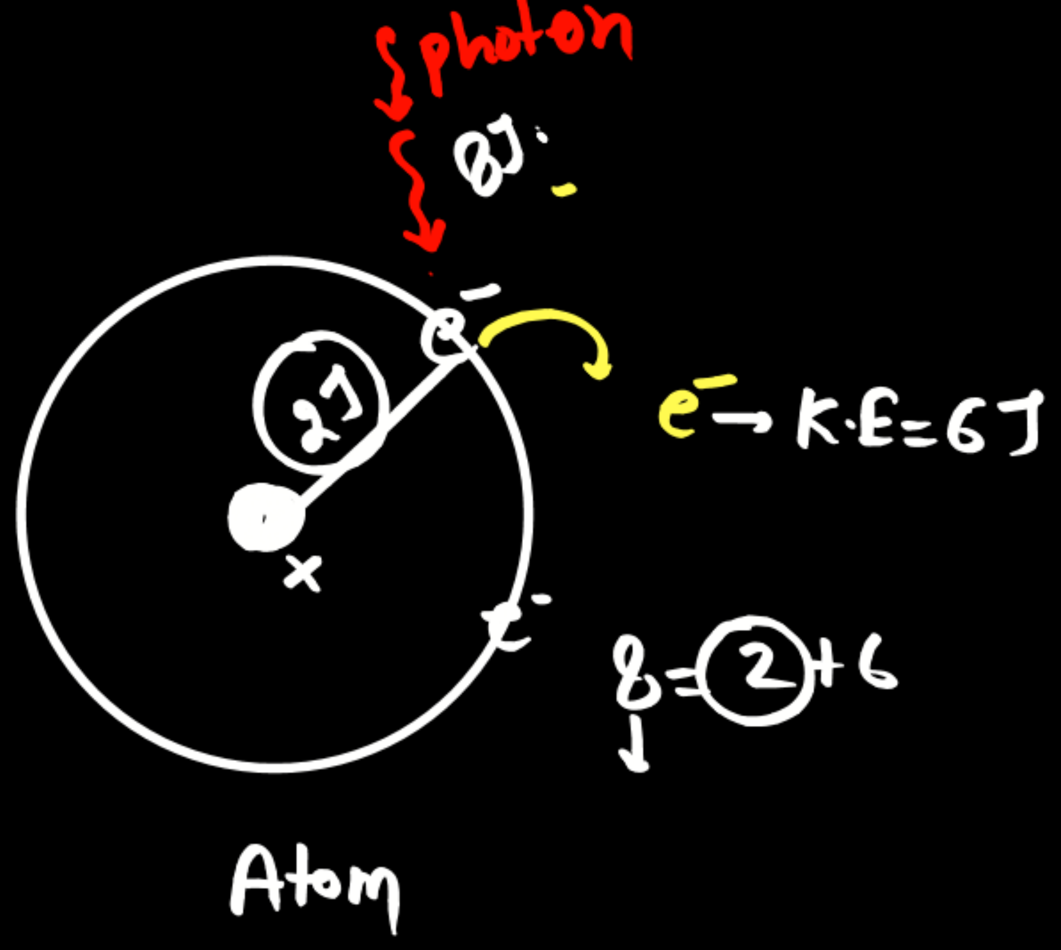
$$L_1 = 2L_2$$

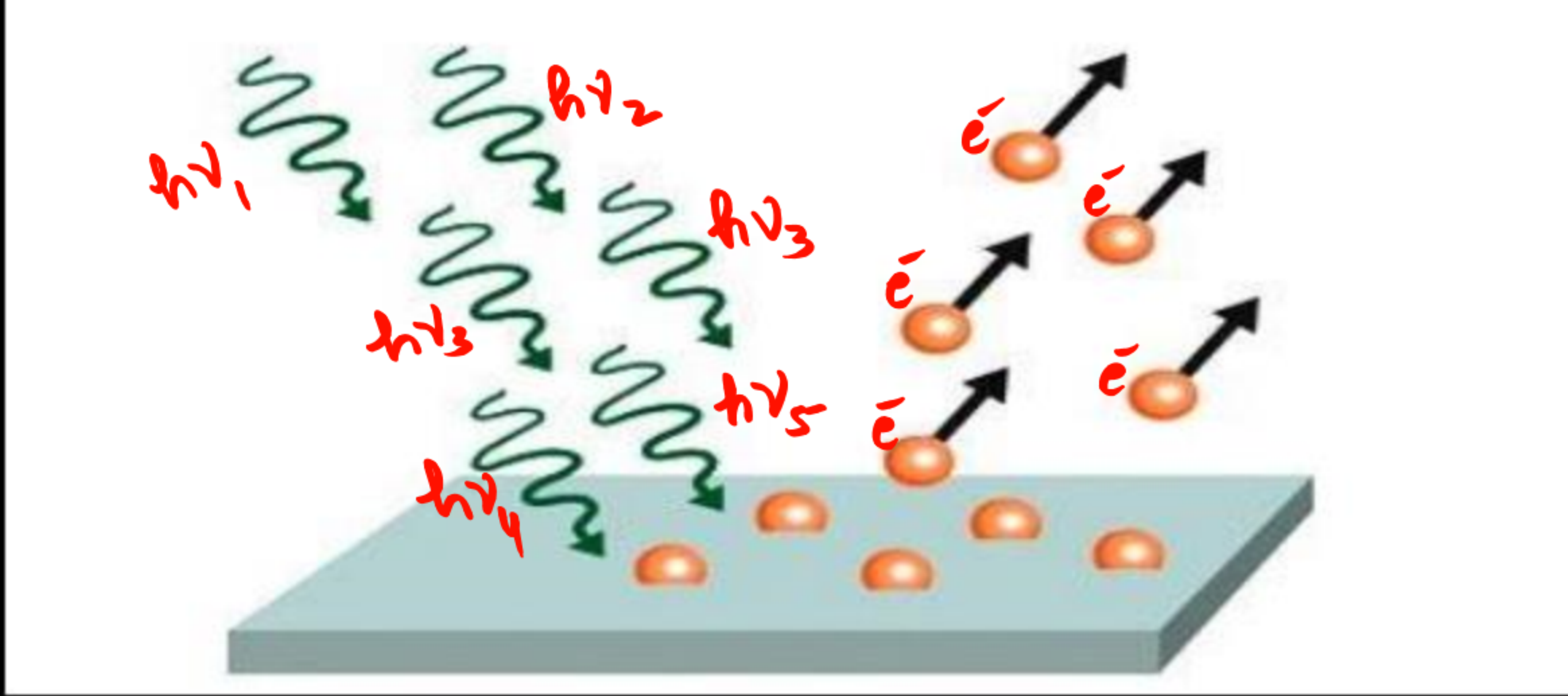
$\frac{?}{3}$

Photoelectric Effect



Light
Photon = hν = hc/λ
Detector
Metal surface
Electrons
Ammeter
Vacuum chamber (Air → x)
+
−
Battery
Low I.E.
K, Cs etc





* Surface phenomenia
* 1 photon = 1 e^- release and remaining convert K.E. of e^-
* $h\nu = W_0 + K.E.$

W_0 = work function = total min. req. energy to emit single e^- for metal surface

$$W_0 = h\nu_0 = \frac{hc}{\lambda_0}$$

CSD * surface phenomina

* Example of particle nature of light

* 1 photon always release 1 e^- and excess energy convert into K.E. of e^-

* $h\nu = W_0 + K.E.$

* $h\nu = h\nu_0 + K.E.$

* $\frac{hc}{\lambda} = \frac{hc}{\lambda_0} + \frac{1}{2} m_e v_e^2$

ν_0 → threshold frequency

λ_0 = threshold wavelength

W_0 = work function (min. energy to remove e^- for metal surface)

→ $h\nu \geq W_0$, $\nu \geq \nu_0$, $\lambda \leq \lambda_0$ = e^- emitted

→ $h\nu < W_0$, $\nu < \nu_0$, $\lambda > \lambda_0$ = not e^- emitted

Q → 10 J energy photon incident in metal surface ($W_0 = 2J$)

How many e^- emitted per photon

a) 1   b) 2   c) 5   d) 4

Q) Calculate K.E. of emitted e^-

a) 10 J   b) 8 J   c) 6 J   d) zero

$$\underset{}{10J} = \underset{W_0}{2J} + \underset{K.E.}{8J}$$

Q Metal surface | Work funct^n (W_0)

Metal surface	Work function (W_0)
A	✓ 3 > 2J
B	3 < 4J → ✗
C	✓ 3 = 3J
D	✓ 3 > 1.5J

a) A

b) A, B, C

✓ c) A, C, D

d) All

How many metal surface show photo electric effect, If 3J photon incident in each metal surface

$E_{photon} \geq W_0$

[2019 Main, 12 Jan I]

What is the work function of the metal, if the light of wavelength 400 Å generates photoelectron of velocity $6 \times 10^5\ ms^{-1}$ from it?
(Mass of electron = 9×10^{31} kg
Velocity of light = $3 \times 10^8\ ms^{-1}$
Planck's constant = 6.626×10^{-34} Js
Charge of electron = 1.6×10^{-19} Je V^{-1})

(A) 4.0 eV
(B) 2.1 eV
(C) 0.9 eV
(D) 3.1 eV

$\frac{hc}{\lambda} = W_0 + \frac{1}{2} m_e v_e^2$

$\frac{6.6 \times 10^{-34} Js \times 3 \times 10^8 \frac{m}{s}}{400 \times 10^{-10} m} = W_0 + \frac{1}{2} \times 9.1 \times 10^{-31} kg \times (6 \times 10^5)^2$

$\frac{6.6 \times 3}{4} \times 10^{-18} J = W_0 + \frac{9 \times 6 \times 6}{2} \times 10^{-21} J$

Q41. In the photoelectron emission, the energy of the emitted electron is

K.E.

[CBSE AIPMT 1994]

(a) greater than the incident photon

(b) same as that of the incident photon

(c) smaller than the incident photon ✓

(d) Proportional to the intensity of incident

$h\nu > K.E.$

$h\nu = W_0 + K.E.$

$h\nu > K.E.$

$E_{photon} \geq W_0$

→ K.E. of $e^- < 8J$

8J → photon

e^- → e^- → K.E. = 6

2J

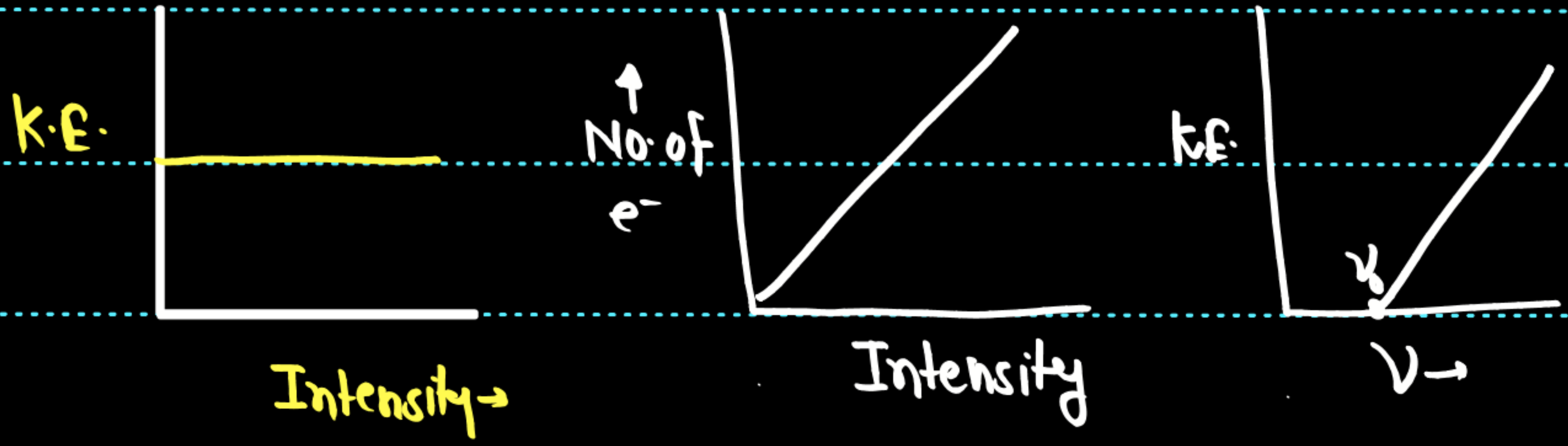
Intensity of photon = total No. of photon incident per unit Area per second.

$h\nu\uparrow$

Intensity $\rightarrow \uparrow$ = No. of photon $\rightarrow \uparrow$ = emitted e^- No. $\rightarrow$ Jada

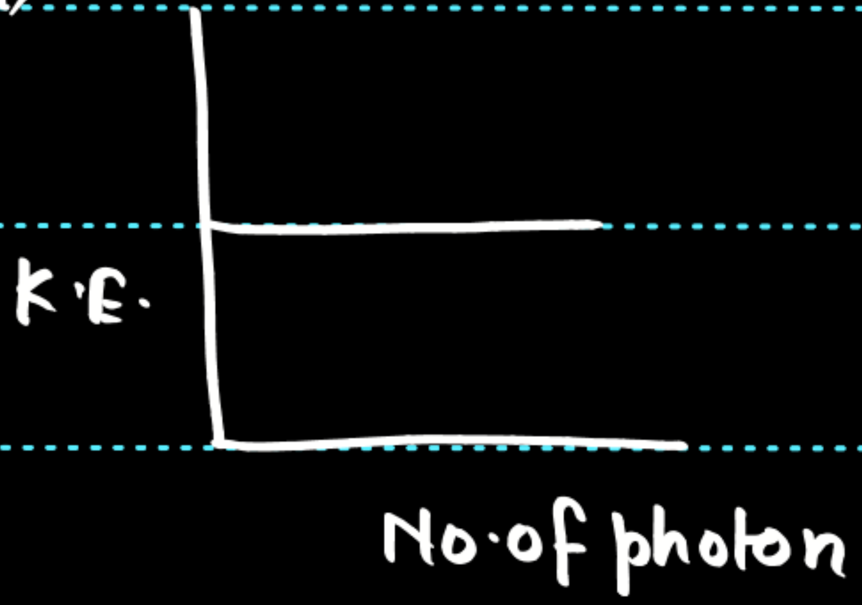
Intensity $\downarrow$ = No. of photon $\rightarrow \downarrow$ = emitted e^- No. $\rightarrow$ Kam

} K.E. = same

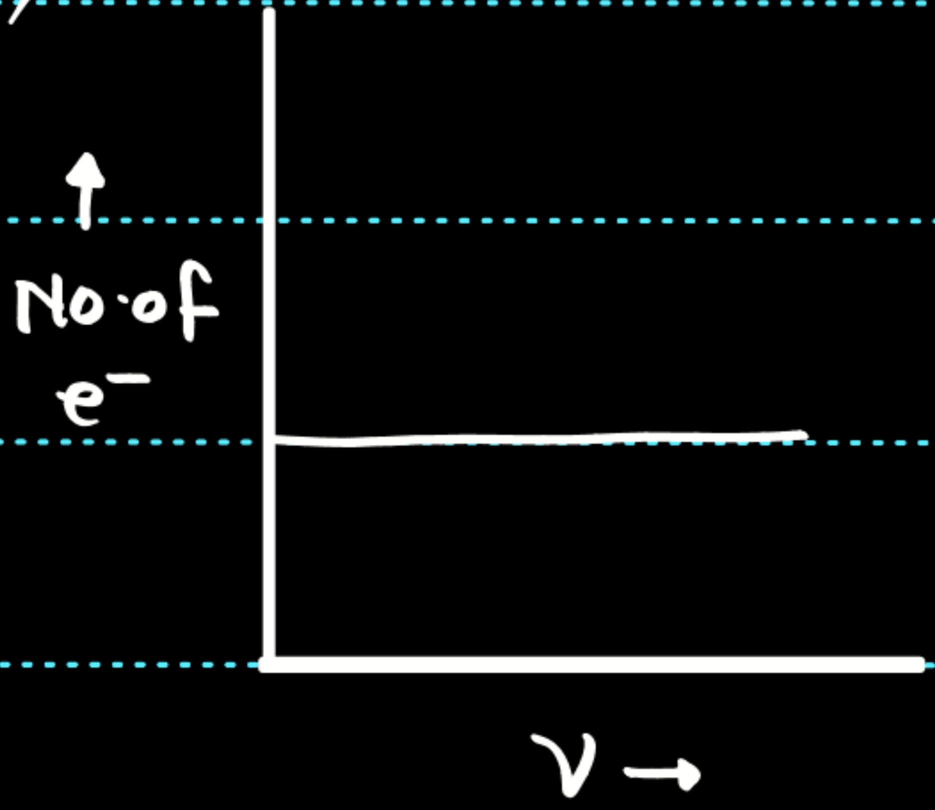


Q Select Correct graph

a)



b)



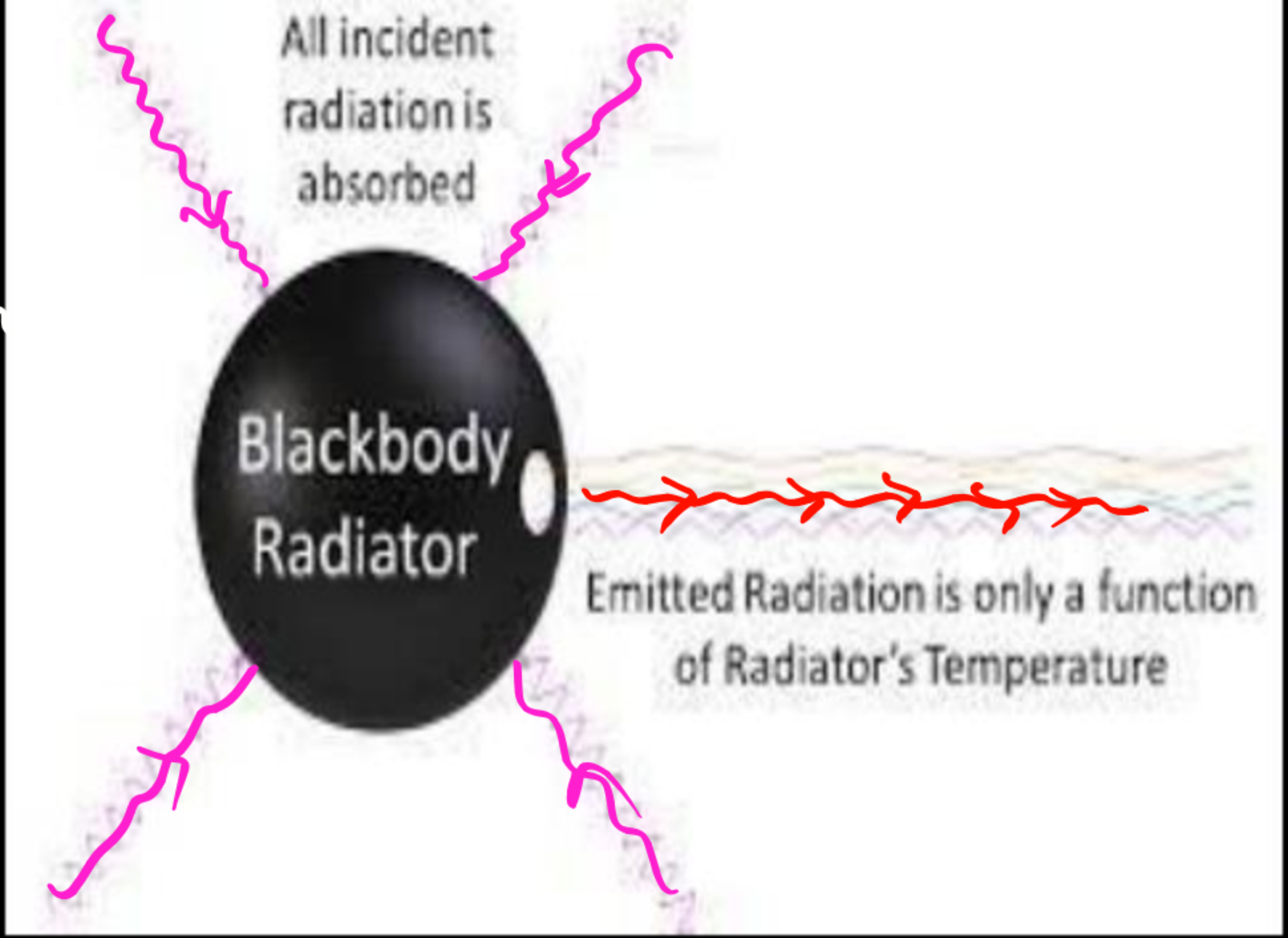
c) both Correct

d) NONE

Black body radiation

* absorbed all type incident radiation
  = perfect black body → ×

* Absorbed all type of incident radiation and emitted (radiate) Specific wavelength (Radiation)
  = Blackbody

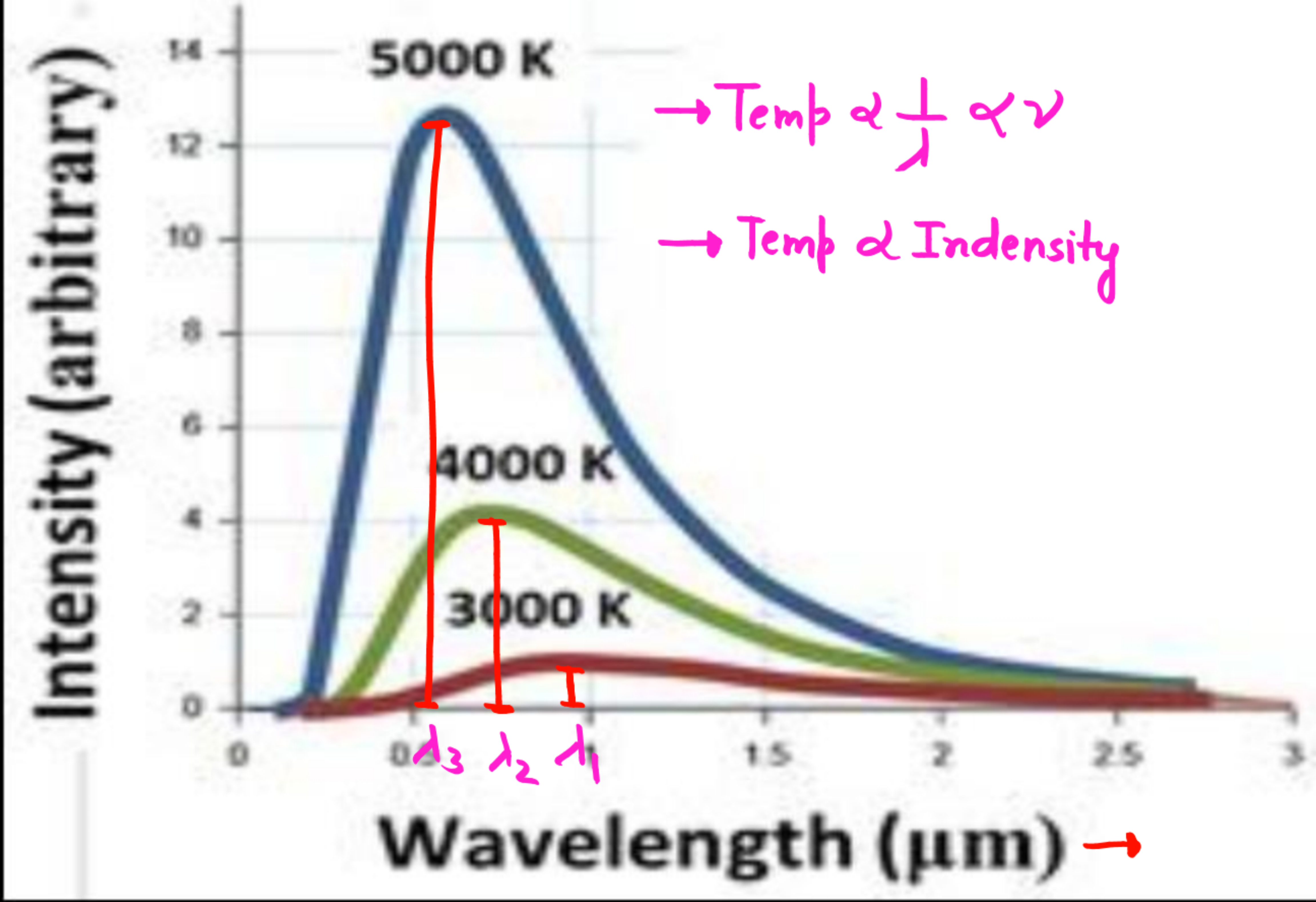


* particle nature of light = Example

* Intensity of Radiation $\propto$ temp.

* $\lambda \propto \frac{1}{temp}$

* $\nu \propto$ temp.



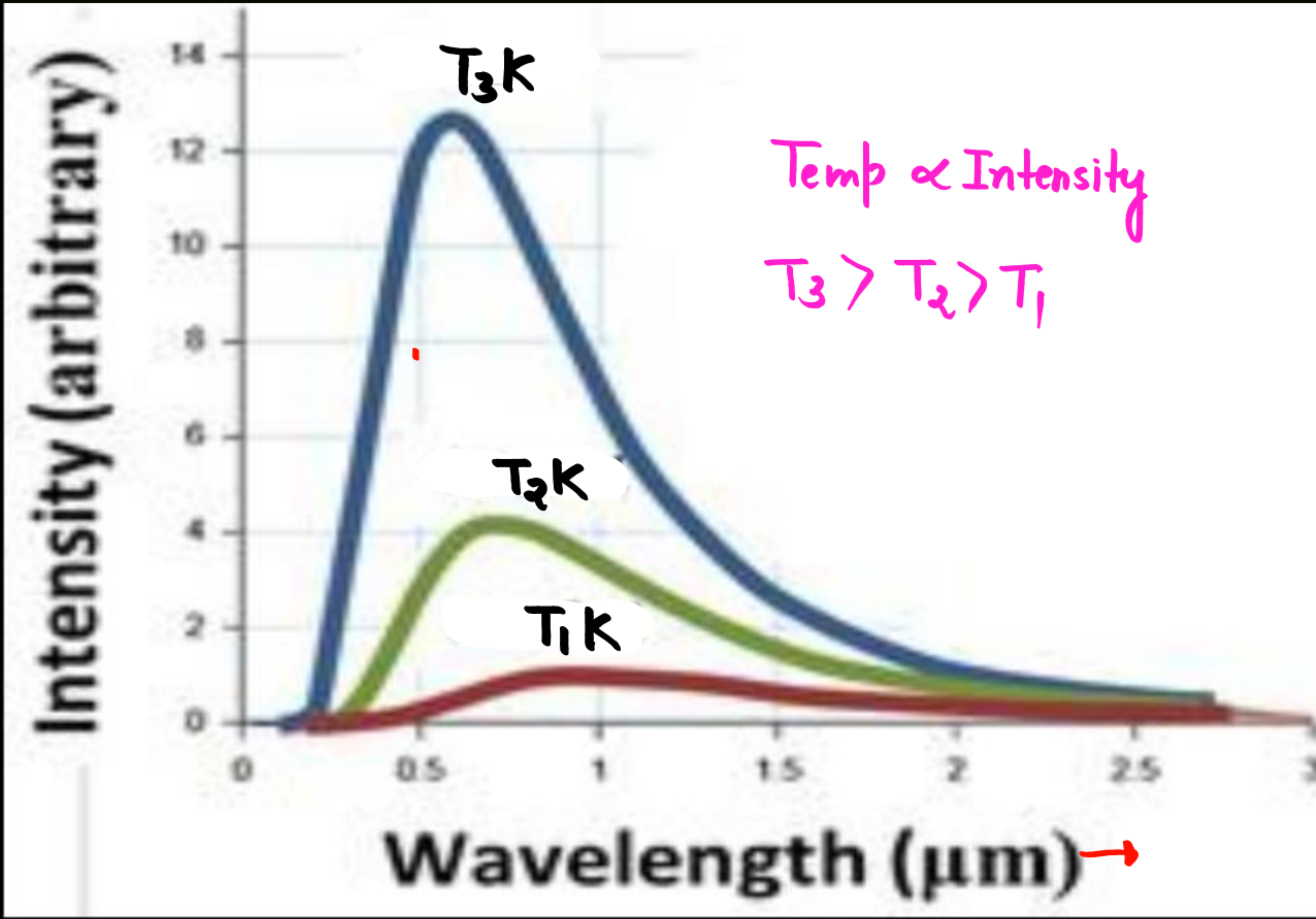
Q → Arrange increasing order of temp. in given graph.

a) $T_1 = T_2 = T_3$

b) $T_1 < T_2 < T_3$ ✓

c) $T_1 > T_2 > T_3$

d) NONE



Temp ∝ Intensity

$T_3 > T_2 > T_1$

Hydrogen spectrum

* Example of particle nature of light

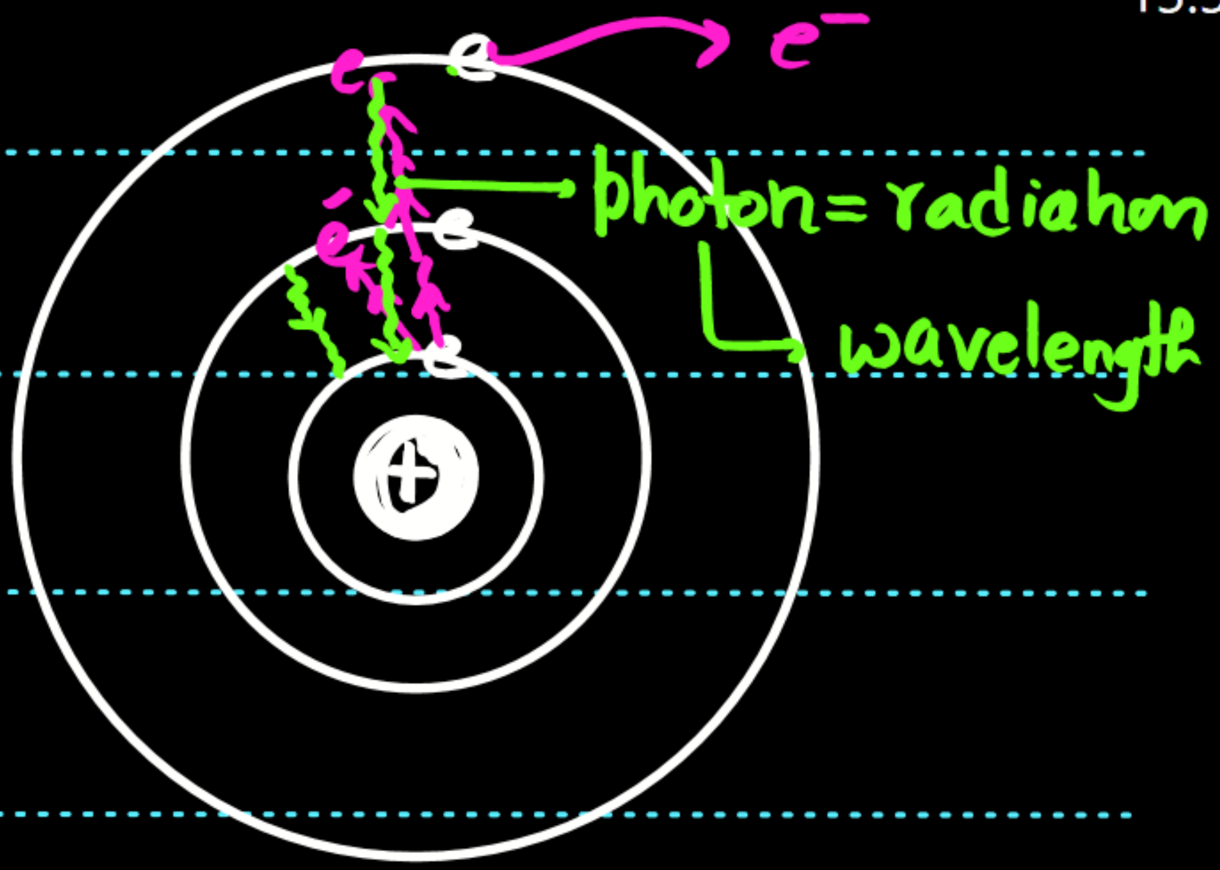
* discharge tube → H_2 gas + high Voltage

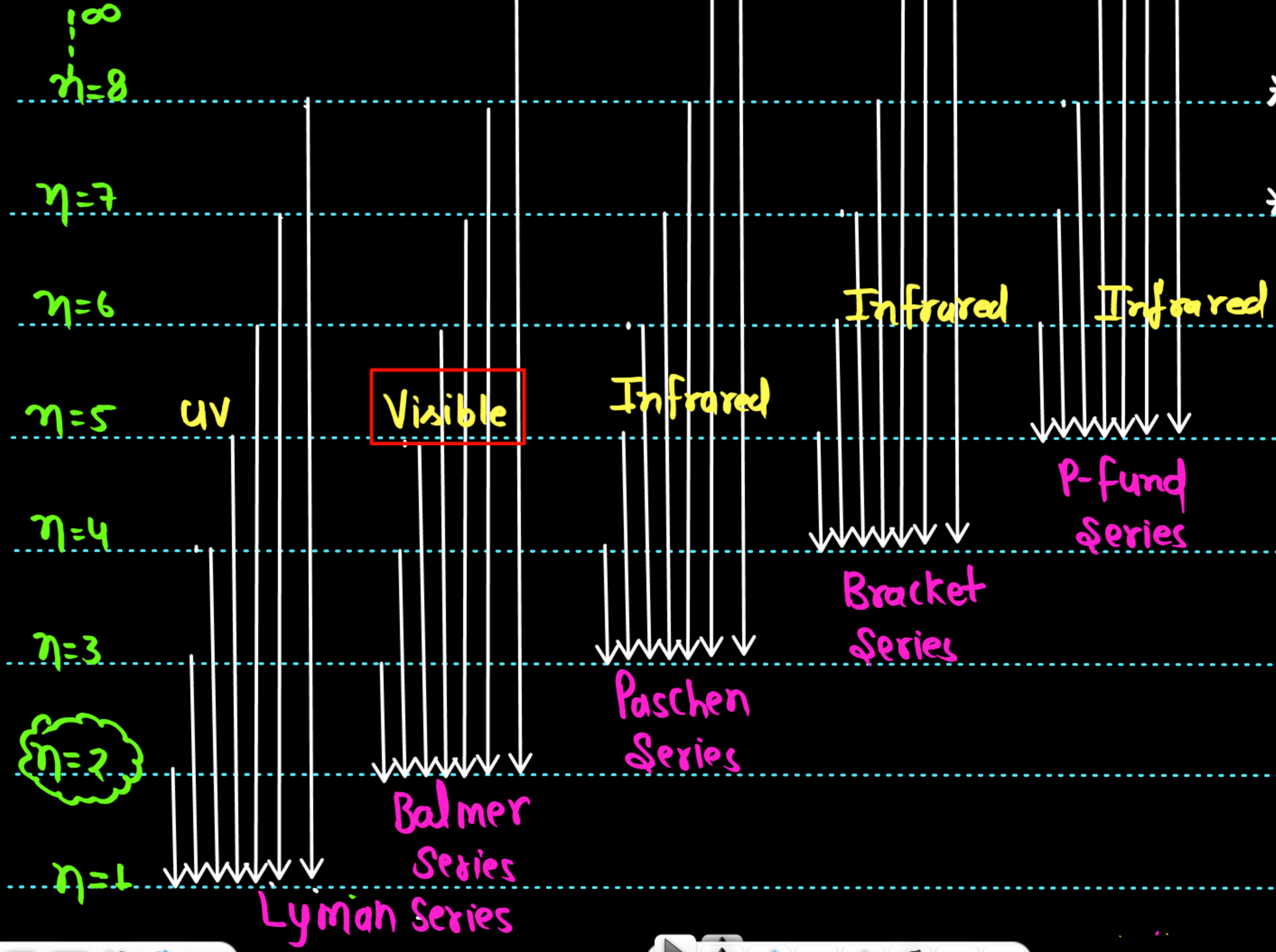
$H_2 \rightarrow H - H \rightarrow H + H$ atom

2-possibility

1) $H \rightarrow H^+ + e^- \rightarrow$ Ionisation

2) H (lower energy level) ⟶ H^* (higher Energy level) → Excitation



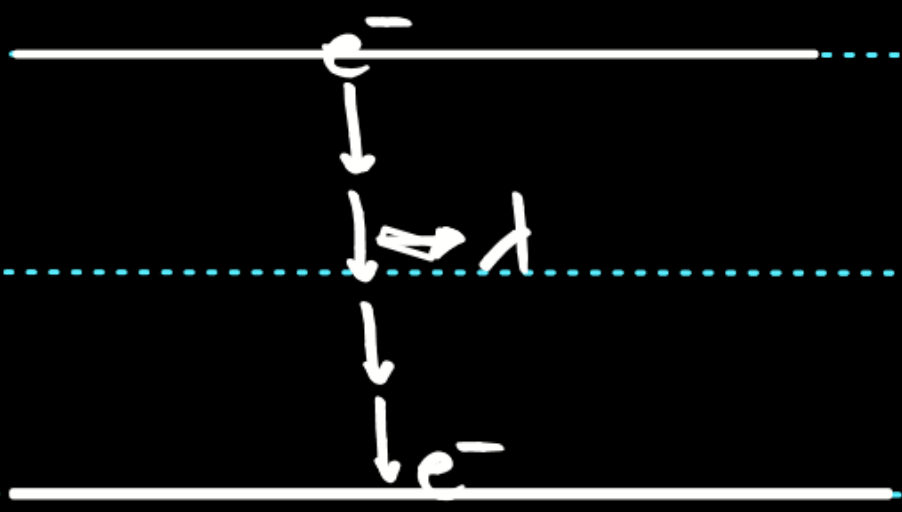


* Line spectrum

* applicable only single $\bar{e}$ species

H, He^{+}, Li^{+2}, Be^{+3}

λ = wavelength of Radiation



E_2 level → n_2

E_1 level → n_1

R = Rydbergy Constant

$= 106977 \ cm^{-1}$

Z = Atomic No. of species

n_1 = lower energy level

n_2 = Upper energy level

$$\Delta E = E_2 - E_1$$

$$\bar{\nu} = \frac{1}{\lambda} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Q → Select Correct value of ground energy level of Balmer series

a) $n_1 = 1$

✓ b) $n_1 = 2$

c) $n_1 = 3$

d) $n_1 = 4$

$n = 3$

$n_1 = 1 \rightarrow \times$

$n_2 = 2 \rightarrow \times$

$n_3 = 3 \rightarrow \times$

Q → Select Correct possible value of upper energy of paschen Series

a) $n = 1$

b) $n = 3$

c) $n = 2$

✓ d) $n = 4$

MANTHAN NEET 2025

CHEMISTRY

ATOMIC STRUCUTURE

Lecture-04

→ Revision and Question, test
[you-tube]
→ 7.00 pm



Sarvesh Sir

Qsd-1 10J photon incident in given metal surface which one release e^- with K.E.

10J



a) ~~Na(s) (W = 10J)~~ → K.E = 0

b) Cs(s) (W = 12J) → ✗ W > 10J

c) ✓ K(s) (W = 8J) → 8 + 2 (K.E.)

d) Zn(s) (W = 15J) → ✗

Q → If the value of frequency of incident photon is double than K.E. of e^- increases

a) double

b) less than double

✓ c) greater than double

d) equal to 4 times

$$h\nu = W_0 + K_1 \quad —(1)$$

$$2h\nu = W_0 + K_2$$

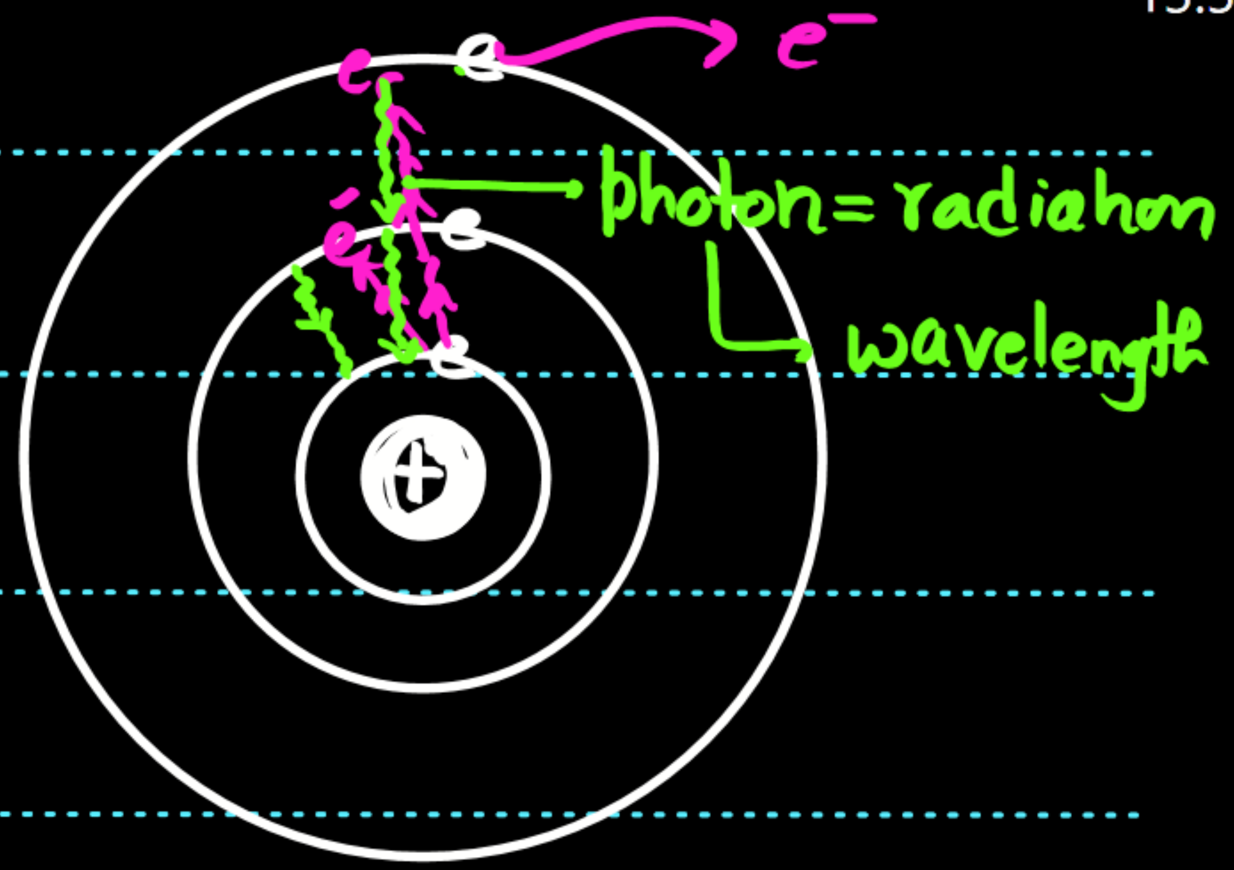
$$2(W_0 + K_1) = W_0 + K_2$$

$$2W_0 + 2K_1 = W_0 + K_2$$

$$\boxed{2K_1 + W_0 = K_2}$$

$$\frac{?}{2}$$

Hydrogen spectrum



* Example of particle nature of light

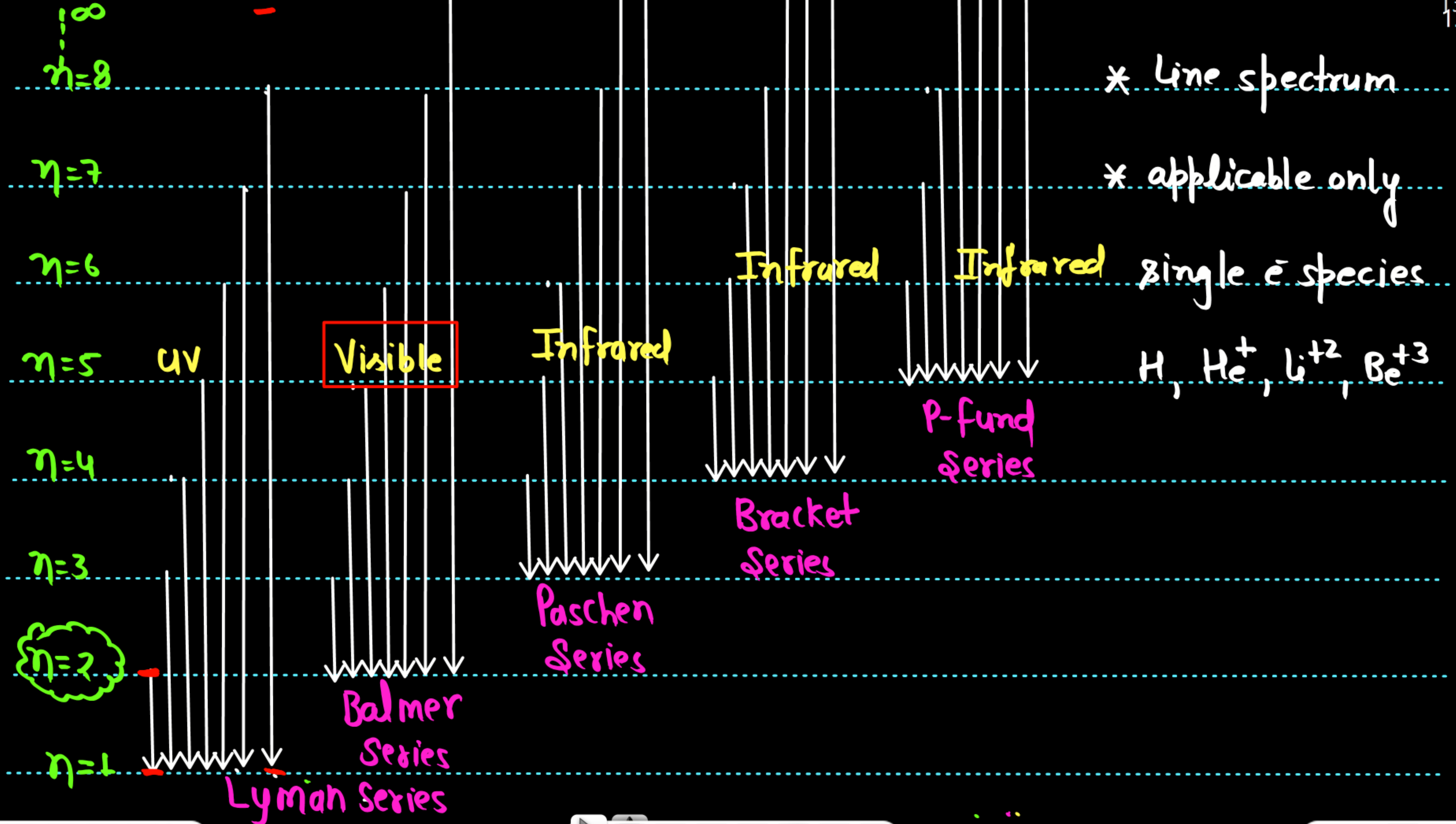
* discharge tube → H_2 gas + high voltage

$$H_2 \rightarrow H - H \rightarrow H + H \text{ atom}$$

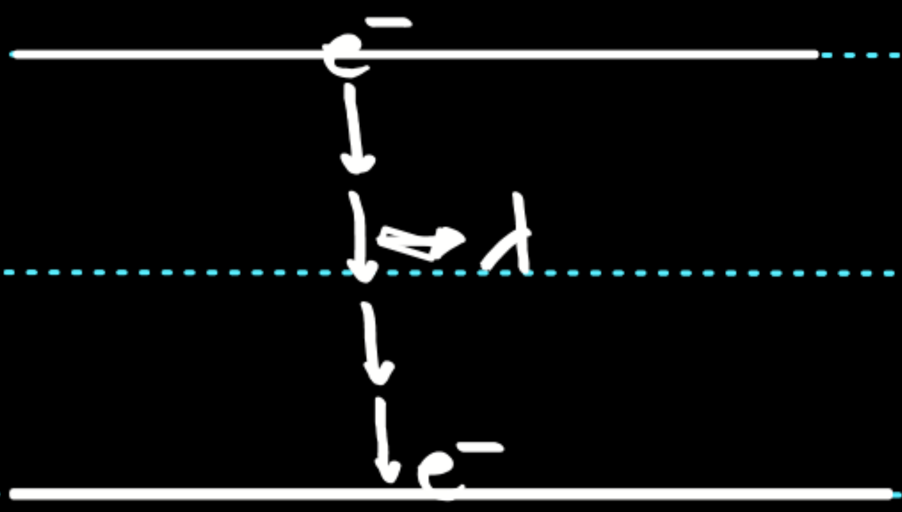
2-possibility

1) $H \rightarrow H^+ + e^-$ → Ionisation

2) H (lower energy level) → H^* (higher Energy level) → Excitation



∞
n=8
n=7
n=6
n=5
n=4
n=3
n=2
n=1
UV
Visible
Infrared
Infrared
Infrared
Lyman Series
Balmer Series
Paschen Series
Bracket Series
P-fund Series
* Line spectrum
* applicable only single ē species
H, He+, Li+2, Be+3



E_2 level → n_2

E_1 level → n_1

$\Delta E = E_2 - E_1$

$$\bar{\nu} = \frac{1}{\lambda} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

λ = wavelength of Radiation

R = Rydbergy Constant

= 106977 cm^{-1}

Z = Atomic No. of species

n_1 = lower energy level

n_2 = upper energy level

Series	Transition	Formula	λ_{max}	λ_{min}
Lyman Series (UV)	→ $n_1 = 1$, $n_2 = 2$ to ∞	$\frac{1}{\lambda} = RZ^2\left(\frac{1}{1^2} - \frac{1}{n^2}\right)$	$n = 2$	$n = \infty$
Balmer Series (Visible)	$n_1 = 2$, $n_2 = 3$ to ∞	$\frac{1}{\lambda} = RZ^2\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$	$n = 3$	$n = \infty$
Paschen Series (IR)	$n_1 = 3$, $n_2 = 4$ to ∞	$\frac{1}{\lambda} = RZ^2\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$	$n = 4$	$n = \infty$
Bracket Series (IR)	$n_1 = 4$, $n_2 = 5$ to ∞	$\frac{1}{\lambda} = RZ^2\left(\frac{1}{4^2} - \frac{1}{n^2}\right)$	$n = 5$	$n = \infty$
Pfund Series (IR)	$n_1 = 5$, $n_2 = 6$ to ∞	$\frac{1}{\lambda} = RZ^2\left(\frac{1}{5^2} - \frac{1}{n^2}\right)$	$n = 6$	$n = \infty$

$$\uparrow \Delta E = \frac{hc}{\lambda \downarrow}$$

$$\Delta E \propto \frac{1}{\lambda}$$

$$\lambda_{max} \propto \frac{1}{(\Delta E)_{min}}$$

$$\lambda_{min} \propto \frac{1}{(\Delta E)_{max}}$$

Q → Calculate highest wavelength of Balmer Series of H-atom

a) $\frac{3}{R}$ b) $\frac{6}{R}$ c) $\frac{5}{36R}$ d) NONE ✓

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{2^2} - \frac{1}{n^2}\right) \rightarrow \lambda_{max} \rightarrow n = 3$$

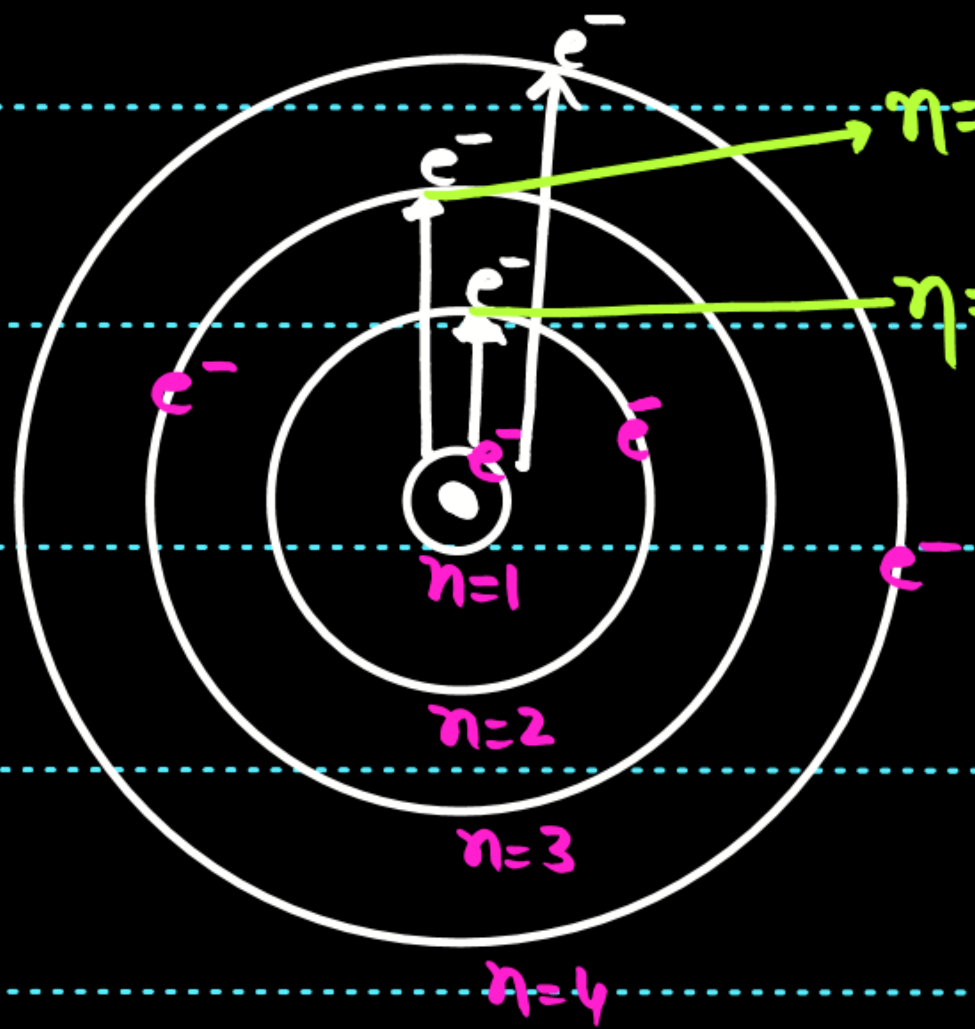
$$\frac{1}{\lambda} = R(1)^2\left[\frac{1}{4} - \frac{1}{9}\right]$$

$$\frac{1}{\lambda} = R\left(\frac{9-4}{9\times4}\right)$$

$$\frac{1}{\lambda} = \frac{5R}{36}$$

$$\boxed{\lambda = \frac{36}{5R}}$$

Excited state



ground state = Jis orbit (shell or energy level) me revolving Kr raha hai

Ground state → 1, 2, 3, - - -

In general $n=1$ suppose Kiya jata hai

→ $n=1$ (revolving) → Excited state = 2, 3, 4, 5 - - -

→ $n=2$ (Revolving) → Excited State = 3, 4, 5, 6 - - -

1^{st} Excited State

2^{n} Exited state

x^{th} Excited state ⇒ $n = x+1$

Q → electron revolving in 2nd excited state of H-atom, Calculate value of energy level of excited state

a) $n = 2$

b) $n = 3$ ✓

c) $n = 1$

d) $n = 4$

2nd excited state → $n = 2 + 1 = 3$

Q16: Which of the following series of transitions in the spectrum of hydrogen atom falls in visible region?

(A) Balmer series

(B) Paschen series

(C) Brackett series

(D) Lyman series

NEET

Q24. The frequency of radiation emitted when the electron falls from n = 4 to n = 1 in a hydrogen atom will be (Given ionisation energy of H = 2.18×10^{-18} J atom^{-1} and h = 6.625×10^{-34} Js) **[CBSE AIPMT 2004]**

(a) $1.54 \times 10^{15}\ s^{-1}$

(b) $1.03 \times 10^{15}\ s^{-1}$

(c) $3.08 \times 10^{15}\ s^{-1}$

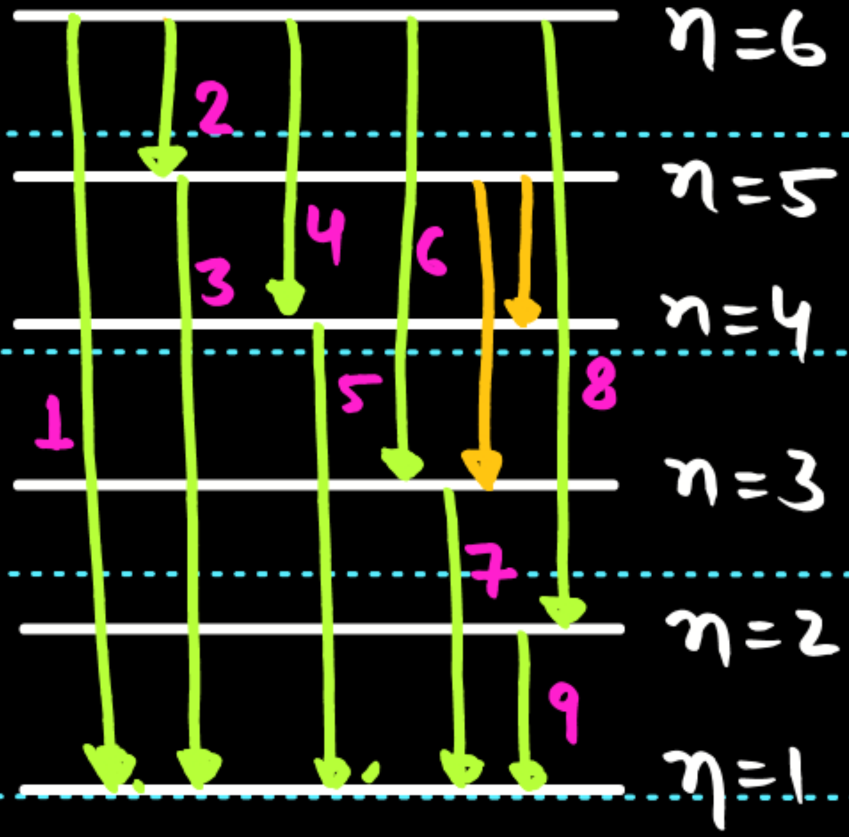
(d) $2.00 \times 10^{15}\ s^{-1}$

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\nu = \frac{c}{\lambda} = cRZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\rightarrow \nu = 3\times10^8 \times 109677 \times (1)^2\left(\frac{1}{1^2} - \frac{1}{4^2}\right)$$

No. of sprectical lines release when e^- jump



a) When e^- jump → n^{th} to ground energy level (n=1)

$$\text{No. of line} = \frac{n(n-1)}{2}$$

b) when e^- jump → n_2^{th} to n_1^{th} (G.E.L → x)

$$= \frac{(n_2-n_1)(n_2-n_1+1)}{2}$$

$$\frac{\cancel{6}^{3} \times 5}{\cancel{2}} = 15$$

**** c) No. of special line in a Series, If e^- jump n^{th} energy level to Ground energy level

= n − No. of n of Series

4−3 = ①

4−2 = ②

4−1 = ③

Q → How many sprectical line release when e⁻ jump $n=4$ to Ground energy level

a) 4

b) 5

c) 6 ✓

d) 8

$$\frac{n(n-1)}{2} = \frac{4 \times 3}{2} = 6$$

How many sp. line release when e⁻ jump $n_2=5$ to $n_1=2$ energy level.

$$\frac{(n_2-n_1)(n_2-n_1+1)}{2}$$

a) 5

b) 4

c) 7

d) 6 ✓

$$= \frac{3 \times 4}{2} = 6$$

How many sp. line of Balmer series only, when e⁻ jump $n=4$ to group energy level.

a) 2 ✓

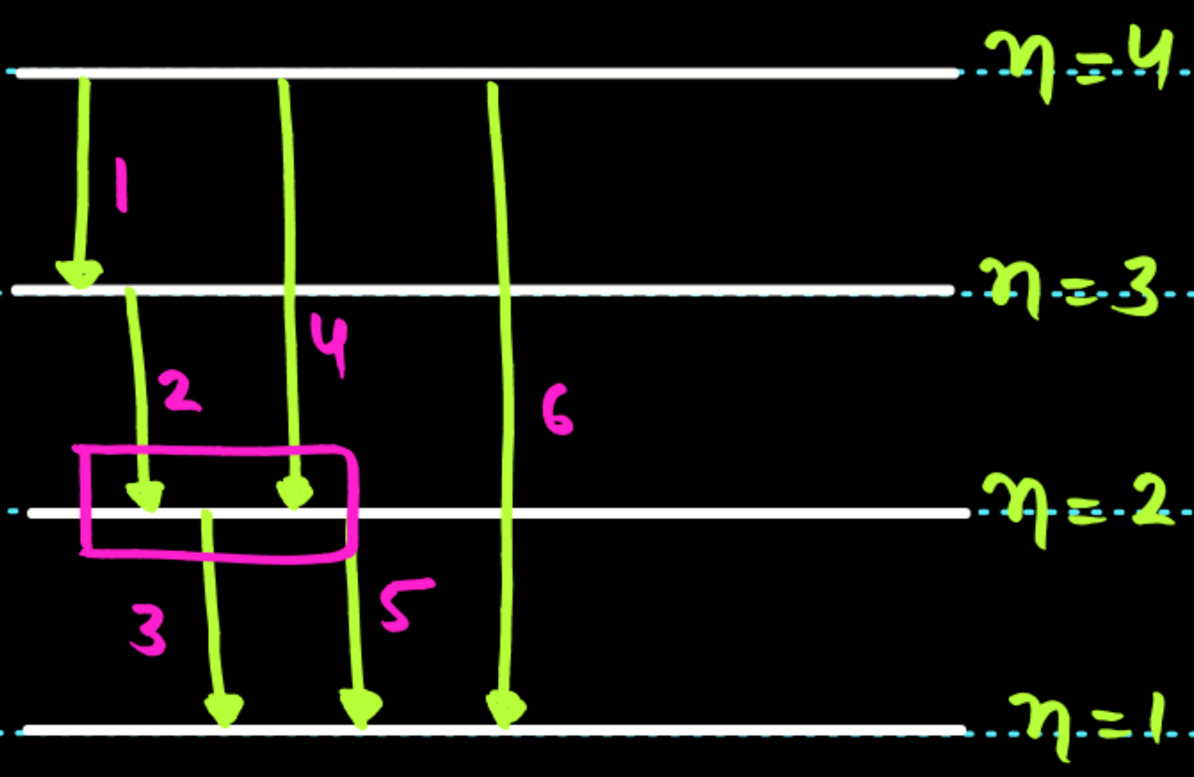
b) 3

c) 6

d) 8

$n_1 = 2 \rightarrow$ Balmer

$4 - 2 = 2$



Q → How many Lyman Series (n=1) line release when e^- jump n=6 to Ground energy level

a) 4 b) 5 ✓ c) 6 d) 3

Sol^n = 6 − 1 = (5)

Balmer = 2 → 4 − 2 = (2)

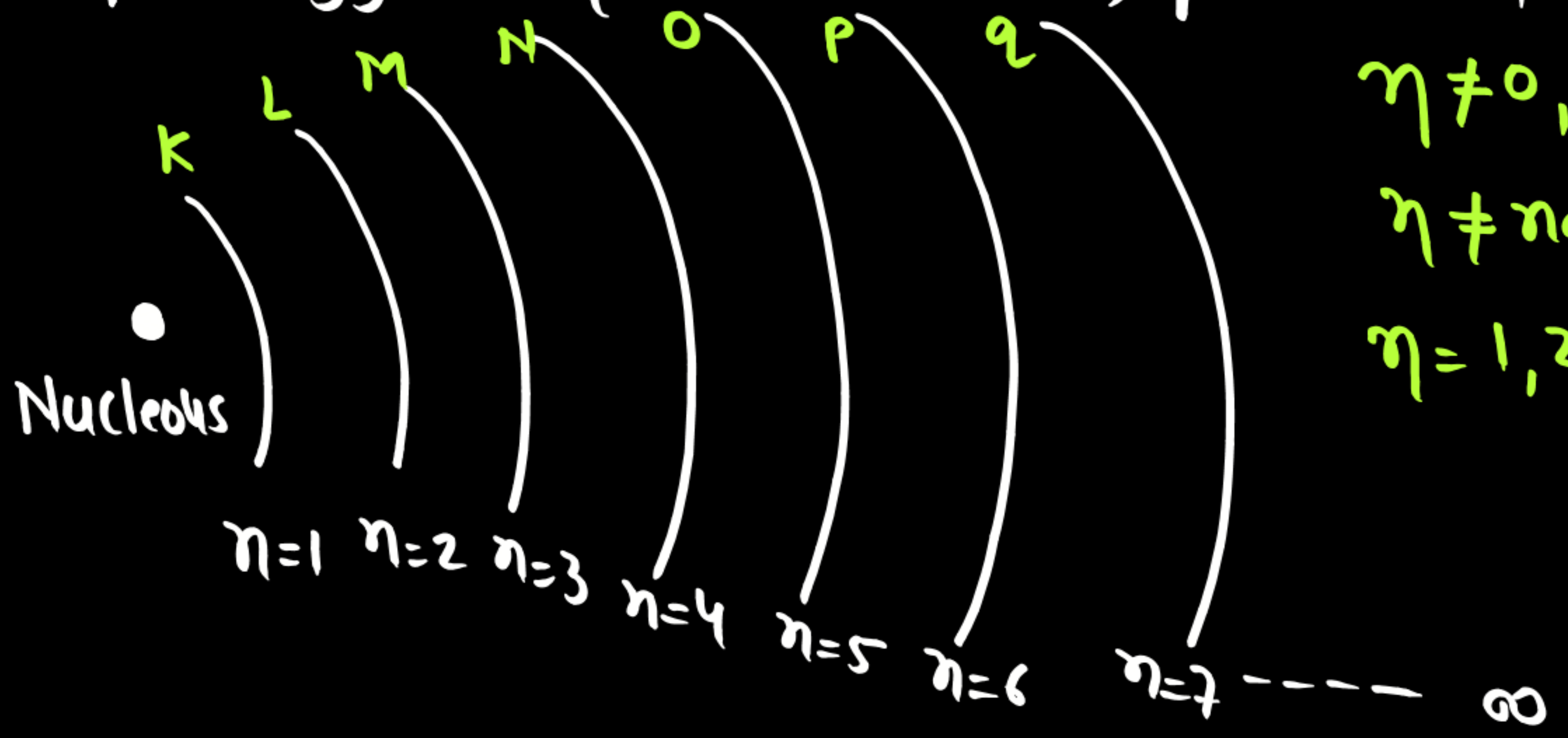
Lyman = 3 → 4 − 1 = (3)

Paschen = 1 → 4 − 3 = (1)

Bohr's atomic model

1) Atom → Nucleous → $r_N = 10^{-15} m$
→ Extra nuclear part
$r_a = 10^{-10} m$

2) No. of energy level (Circular orbit) present in surrounding of nucleous



$n \neq 0$, $n \neq$ fractiond

$n \neq$ negative

$n = 1, 2, 3, 4, 5 ---$

3) $\bar{e}$ revolving only some special circular path (orbit), the angular momentum of those circular path is equal to integral multiple of $\frac{h}{2\pi}$

$$\boxed{mvr = n \times \frac{h}{2\pi}} \rightarrow \frac{h}{2\pi}, \ 2\frac{h}{2\pi}, \ 3\frac{h}{2\pi} \ 4\frac{h}{2\pi} \ldots$$

$n = 1, 2, 3, 4 \ldots$

Q → Select the Correct Value of angular momentum, In which $\bar{e}$ revolving

✓ a) $\frac{h}{\pi}$ ✗ b) $\sqrt{2}\frac{h}{\pi}$ ✗ c) $\sqrt{3} \times \left(\frac{h}{2\pi}\right)$ d) All

$2\left(\frac{h}{2\pi}\right)$ $2\sqrt{2}\left(\frac{h}{2\pi}\right)$

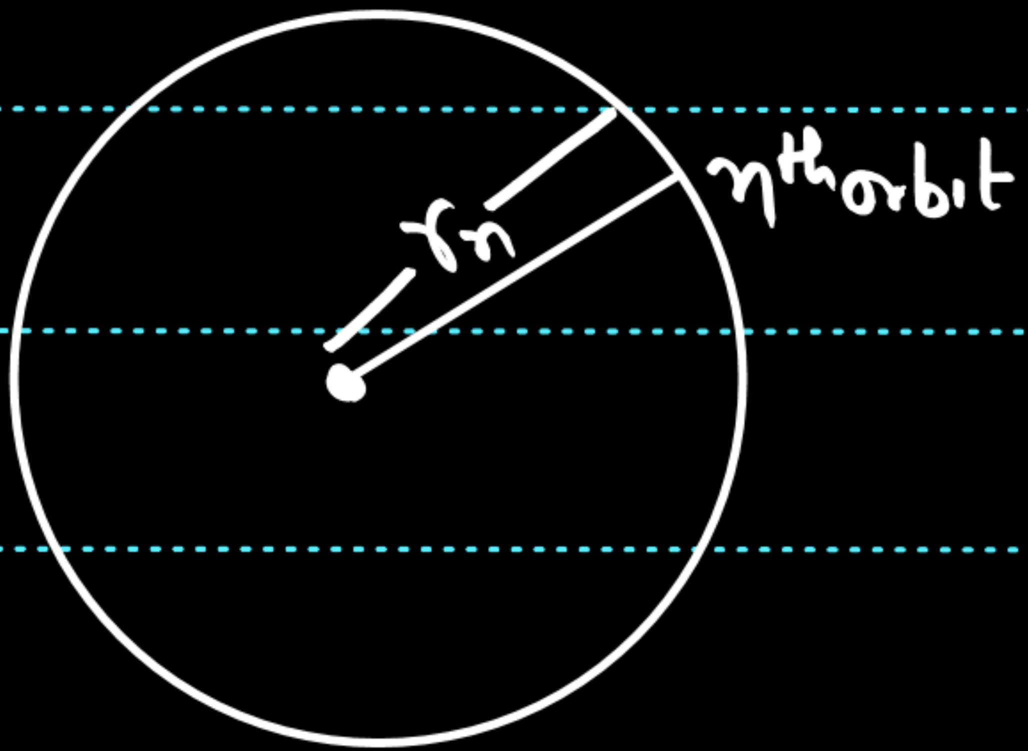
4) Bohr's theory only applicable for single e^- species

H, He^+, Li^{+2}, Be^{+3}

$e^- = 1$ 1   1   1

5) Radius of atom or Radius of n^{th} Energy level

$$r_n = 0.529 \times \frac{n^2}{Z} \, A^0$$



n = No. of orbit (energy level)

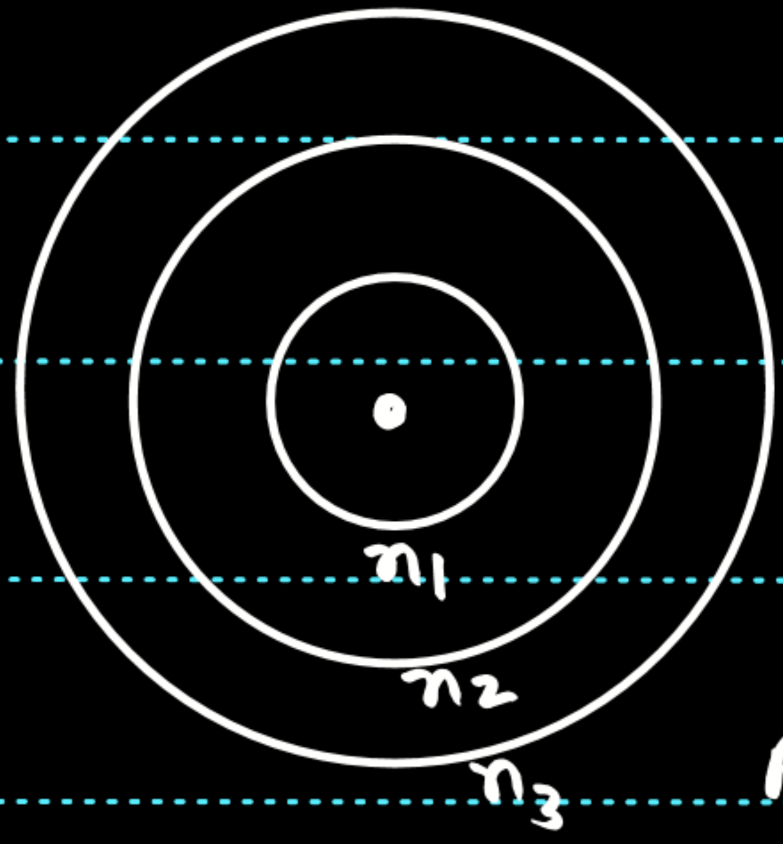
Z = Atomic No. of species

a) Ratio of radius of n_1 & n_2 energy level

$$r_n \propto n^2$$

Csd

$$r_{n_1} : r_{n_2} : r_{n_3} \cdots = n_1^2 : n_2^2 : n_3^2 \cdots$$



Q → Calculate the ratio of first 3 orbit of H-atom

$$r_1 : r_2 : r_3 = (1)^2 : (2)^2 : (3)^2 = 1 : 4 : 9$$

$$\frac{r_3}{r_5} = \frac{3^2}{5^2} = \frac{9}{25}$$

Q → Calculater ratio of 3rd orbital and 5th orbital of H-atom

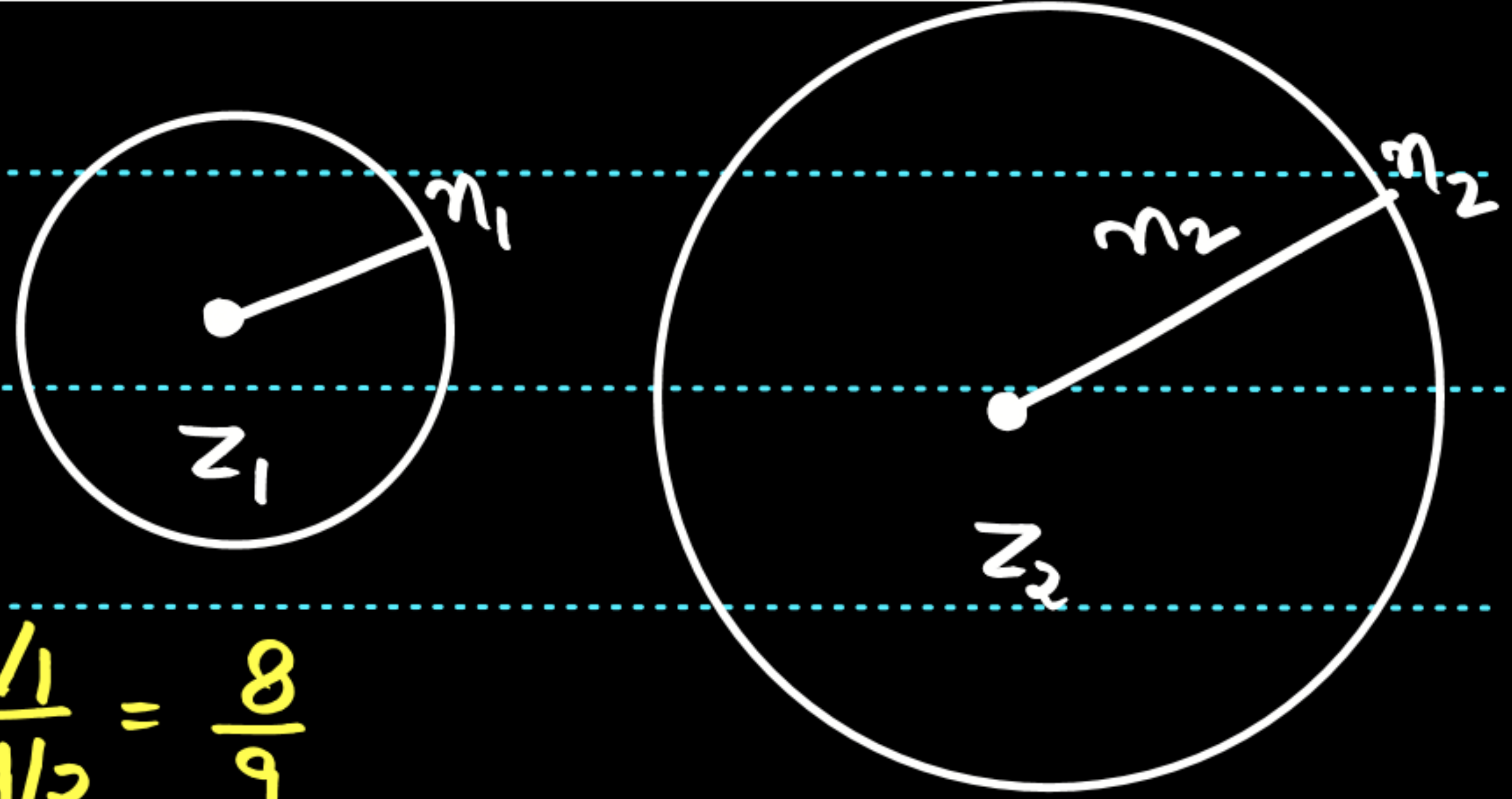
a) 3:5 ✓b) $\frac{9}{25}$ c) $\frac{25}{9}$ d) 5/3

$$r_3 : r_5 = 3^2 : 5^2 = 9 : 25$$

b) Ratio of two different energy level of different atom

$r_n = 0.529 \times \frac{n^2}{Z}$ A°

$$r_{n_1} : r_{n_2} = \left(\frac{n_1^2}{Z_1}\right) : \left(\frac{n_2^2}{Z_2}\right)$$



$$r_2 : r_3 = \left(\frac{2^2}{1}\right) : \frac{3^2}{2} = \frac{4}{1} : \frac{9}{2} = \frac{4/1}{9/2} = \frac{8}{9}$$

Q → Calculate ratio of 2nd orbital of H-atom and 3th orbit of He^+

Q → Radius of 2nd orbit of H-atom is x, Calculate Radius of 3rd orbit of He^+

$$\frac{r_{n_1}}{r_{n_2}} = \frac{\left(n_1^2/Z_1\right)}{\left(n_2^2/Z_2\right)}$$

$$\frac{r_2}{r_3} = \frac{\left(2^2/1\right)}{\left(3^2/2\right)} = \frac{\left(4/1\right)}{\left(9/2\right)} = \frac{8}{9}$$

$$\frac{r_H}{r_{He^+}} = \frac{\left(n_1^2/Z_1\right)}{\left(n_2^2/Z_2\right)}$$

$$\frac{x}{r_{He^+}} = \frac{\left(2^2/1\right)}{\left(3^2/2\right)} \Rightarrow \frac{x}{r_{He^+}} = \frac{8}{9}, \quad \boxed{r_{He^+} = \frac{9x}{8} A^0}$$



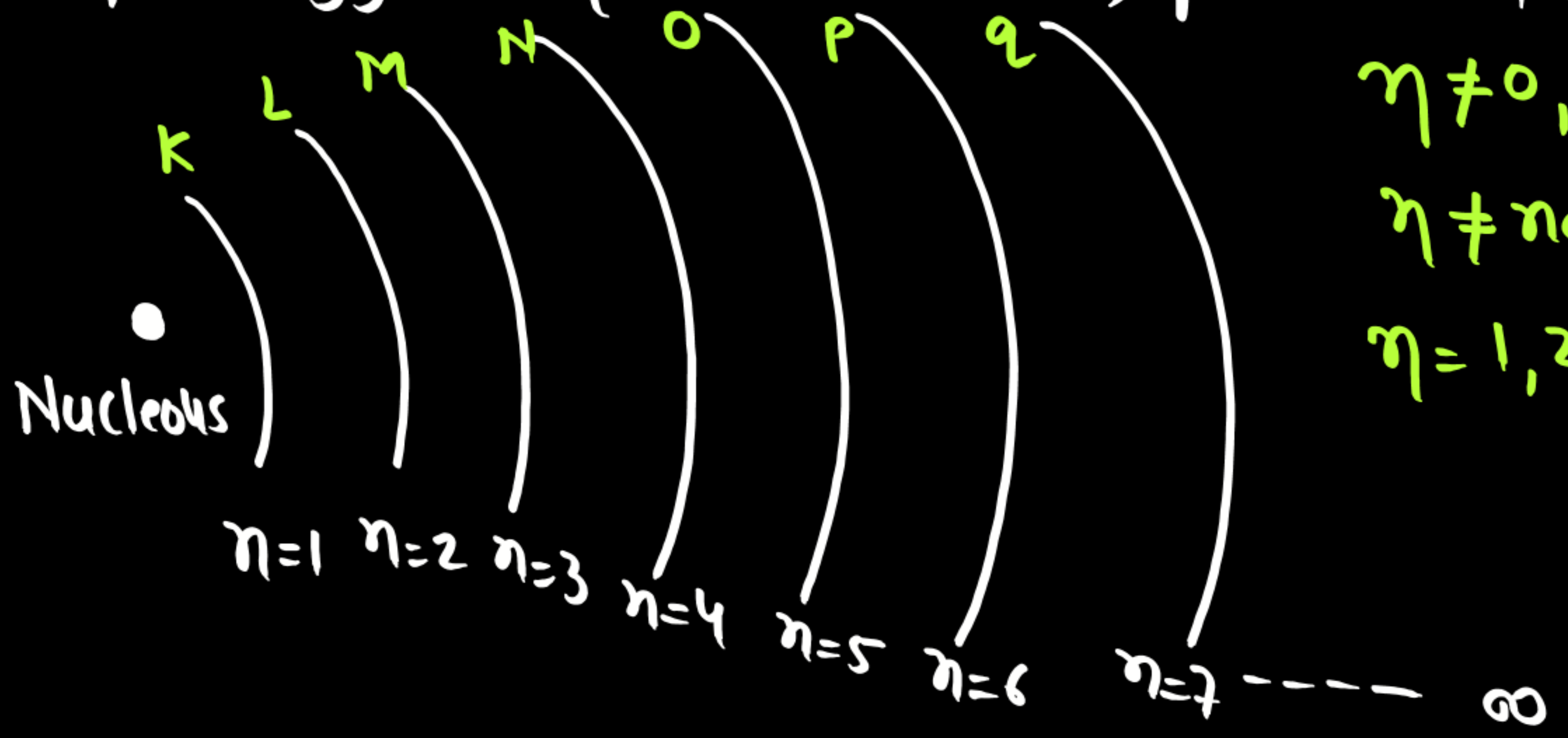
SANKALP NEET
VEDANTU
MANTHAN NEET 2025
2.30hr
→ Atomic structure → 4.00pm
Live
U-tube
Revision → Half NEET
CHEMISTRY
ATOMIC STRUCUTURE
→ Half NEET
→ Question-theory
→ Numerical
Vedantu
MASTER TEACHER
Lecture-05
Sarvesh Sir

Bohr's atomic model

1) Atom → Nucleous → $r_N = 10^{-15} m$
   → Extra nuclear part

$r_a = 10^{-10} m$

2) No. of energy level (Circular orbit) present in surrounding of nucleous



$n \neq 0$, $n \neq$ fractiond

$n \neq$ negative

$n = 1, 2, 3, 4, 5 - - -$

3) $\bar{e}$ revolving only some special circular path (orbit), the angular momentum of those circular path is equal to integral multiple of $\frac{h}{2\pi}$

$$mvr = n \times \frac{h}{2\pi} \rightarrow \frac{h}{2\pi}, 2\frac{h}{2\pi}, 3\frac{h}{2\pi}, 4\frac{h}{2\pi} \ldots$$

$n = 1, 2, 3, 4 \ldots$

Q → Select the Correct Value of angular momentum, In which $\bar{e}$ revolving

✓ a) $\frac{h}{\pi}$ ✗ b) $\frac{\sqrt{2}h}{\pi}$ ✗ c) $\sqrt{3} \times \left(\frac{h}{2\pi}\right)$ d) All

$2\left(\frac{h}{2\pi}\right)$ $2\sqrt{2}\left(\frac{h}{2\pi}\right)$

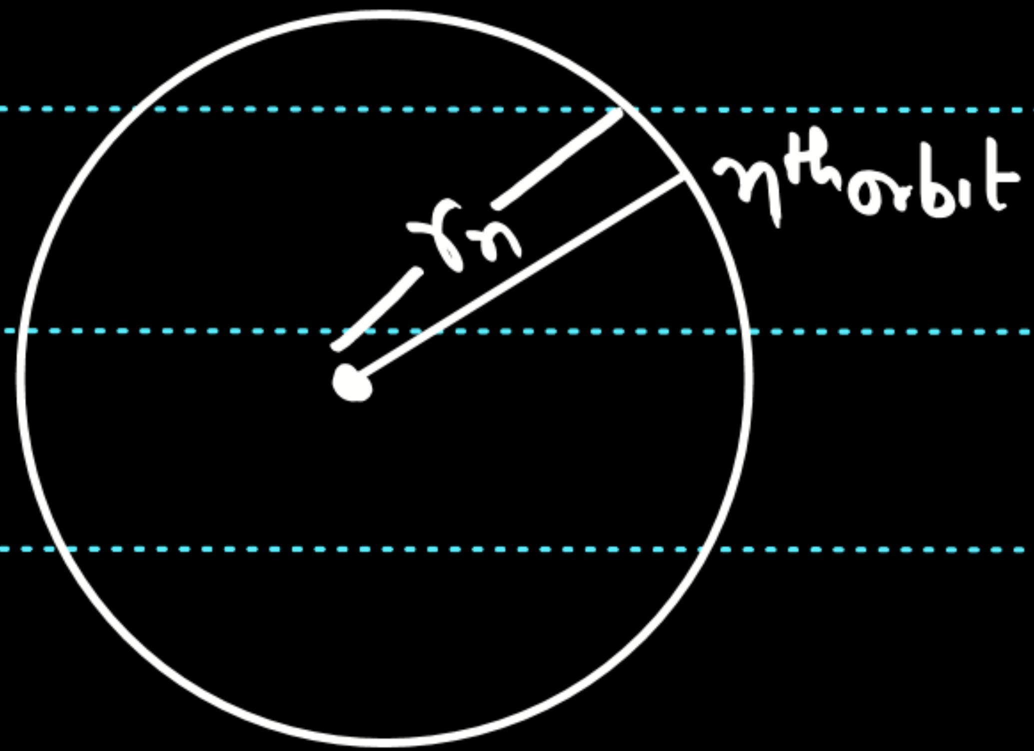
4) Bohr's theory only applicable for single e^- species

H, He^+, Li^{+2}, Be^{+3}

$e^- = 1$ 1 1 1

5) Radius of atom or Radius of n^{th} Energy level

$$r_n = 0.529 \times \frac{n^2}{Z} \, A^0$$



n = No. of orbit (energy level)

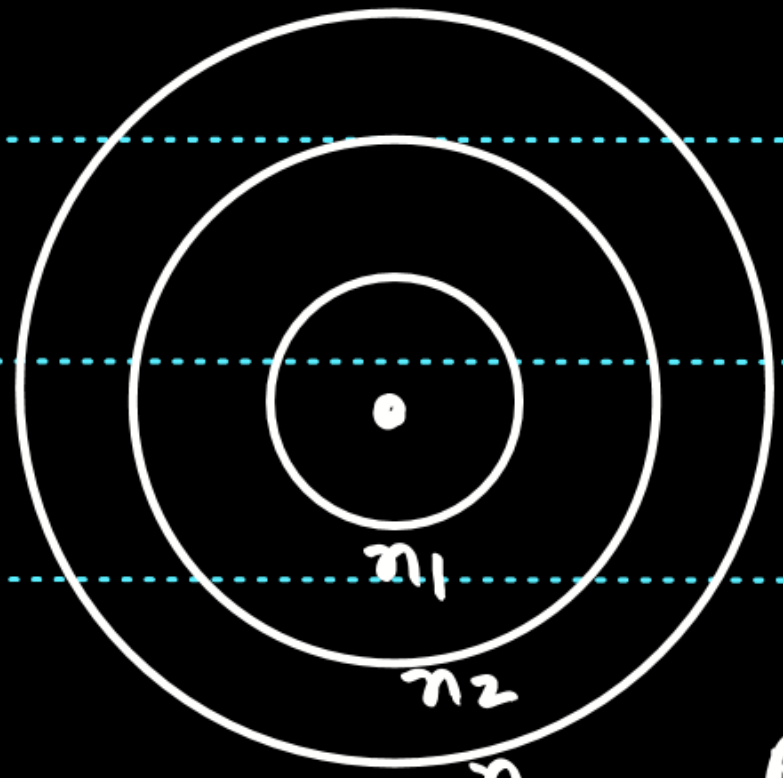
Z = Atomic No. of species

a) Ratio of radius of n_1 & n_2 energy level

$r_n \propto n^2$

Csd

$$r_{n_1} : r_{n_2} : r_{n_3} \cdots = n_1^2 : n_2^2 : n_3^2 \cdots$$



Q → Calculate the ratio of first 3 orbit of H-atom

$$r_1 : r_2 : r_3 = (1)^2 : (2)^2 : (3)^2 = 1 : 4 : 9$$

$$\frac{r_3}{r_5} = \frac{3^2}{5^2} = \frac{9}{25}$$

Q → Calculater ratio of 3rd orbital and 5th orbital of H-atom

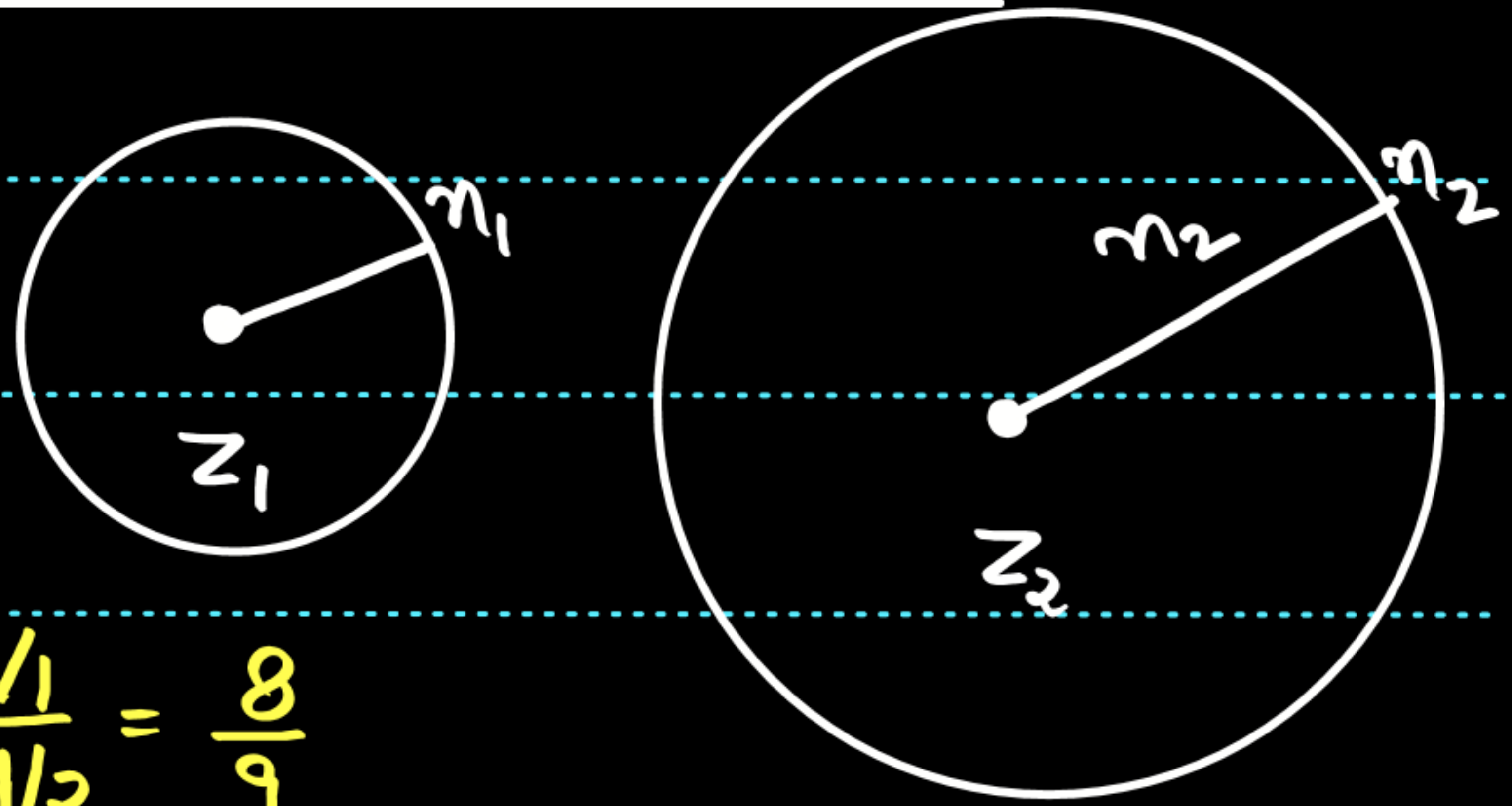
a) 3:5 ✓b) $\frac{9}{25}$ c) $\frac{25}{9}$ d) 5/3

$$r_3 : r_5 = 3^2 : 5^2 = 9 : 25$$

b) Ratio of two different energy level of different atom

$$r_n = 0.529 \times \frac{n^2}{Z} \text{ Å}$$

$$r_{n_1} : r_{n_2} = \left(\frac{n_1^2}{Z_1}\right) : \left(\frac{n_2^2}{Z_2}\right)$$



$$r_2 : r_3 = \left(\frac{2^2}{1}\right) : \frac{3^2}{2} = \frac{4}{1} : \frac{9}{2} = \frac{4/1}{9/2} = \frac{8}{9}$$

Q → Calculate ratio of 2nd orbital of H-atom and 3th orbit of He^+

Q → Radius of 2nd orbit of H-atom is x, Calculate Radius of 3rd orbit of He^+

$$\frac{r_{n_1}}{r_{n_2}} = \frac{(n_1^2/Z_1)}{(n_2^2/Z_2)}$$

$$\frac{r_2}{r_3} = \frac{(2^2/1)}{(3^2/2)} = \frac{(4/1)}{(9/2)} = \frac{8}{9}$$

$$\frac{r_H}{r_{He^+}} = \frac{(n_1^2/Z_1)}{(n_2^2/Z_2)}$$

$$\frac{x}{r_{He^+}} = \frac{(2^2/1)}{(3^2/2)} \Rightarrow \frac{x}{r_{He^+}} = \frac{8}{9}, \quad \boxed{r_{He^+} = \frac{9x}{8} A^0}$$

13:3

Qsd-1 Angular momentum of Revolving electron is

× a) $\frac{h}{4\pi} = \left(\frac{1}{2}\right) \times \frac{h}{2\pi}$ $\qquad n \times \frac{h}{2\pi}$ $\qquad$ (b, c)

n → 1, 2, 3, 4, - - -

✓ b) $2\frac{h}{\pi} = 2 \times \frac{2h}{2\pi} = 4 \times \left(\frac{h}{2\pi}\right)$

✓ c) $7\frac{h}{\pi} \rightarrow 7 \times 2 \times \frac{h}{2\pi} = 14 \times \left(\frac{h}{2\pi}\right)$

d) All

Qsd-2 How many spreehical line release, when e^- jump $n=4$ to $n=1$

a) 6 ✓

b) 4

c) 5

d) 3

$$\frac{n(n-1)}{2}$$

$$= \frac{4 \times 3}{2} = 6$$

$$\frac{?}{2}$$

total energy of n^{th} orbit electron

→ total energy (T.E.) = Potential energy + Kinetic energy

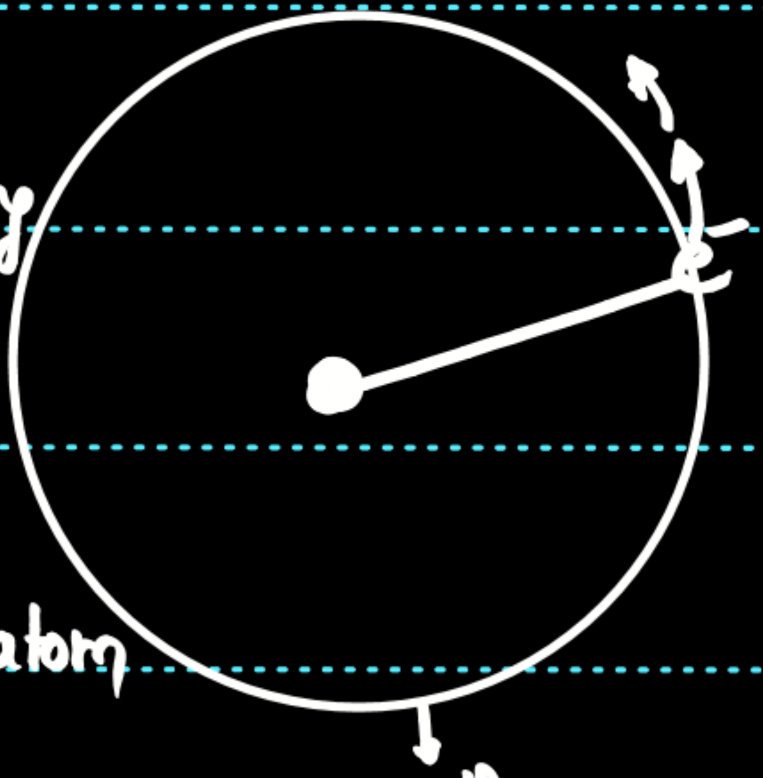
→ At infinite distance → P.E. = 0 suppose

→ $T.E. = -13.6 \times \frac{Z^2}{n^2}$ ev/atom $= -13.6 \times 1.6 \times 10^{-19} \frac{Z^2}{n^2}$ J/atom

$1 ev = 1.6 \times 10^{-19}$ Joule

Meaning = Revolving e^- → Attraction Force or Attraction Energy → P.E=0

se binding energy



Ionisation energy total required energy to remove e^- form atom

$$I.E. = |T.E|$$

$$T.E = -13.6 \times \frac{Z^2}{n^2} \text{ ev/atom}$$

Q → total energy required to removal of 2nd orbit revolving e^- for H-atom

a) +13.6ev b) +5.4ev ✓c) +3.4ev

d) NONE

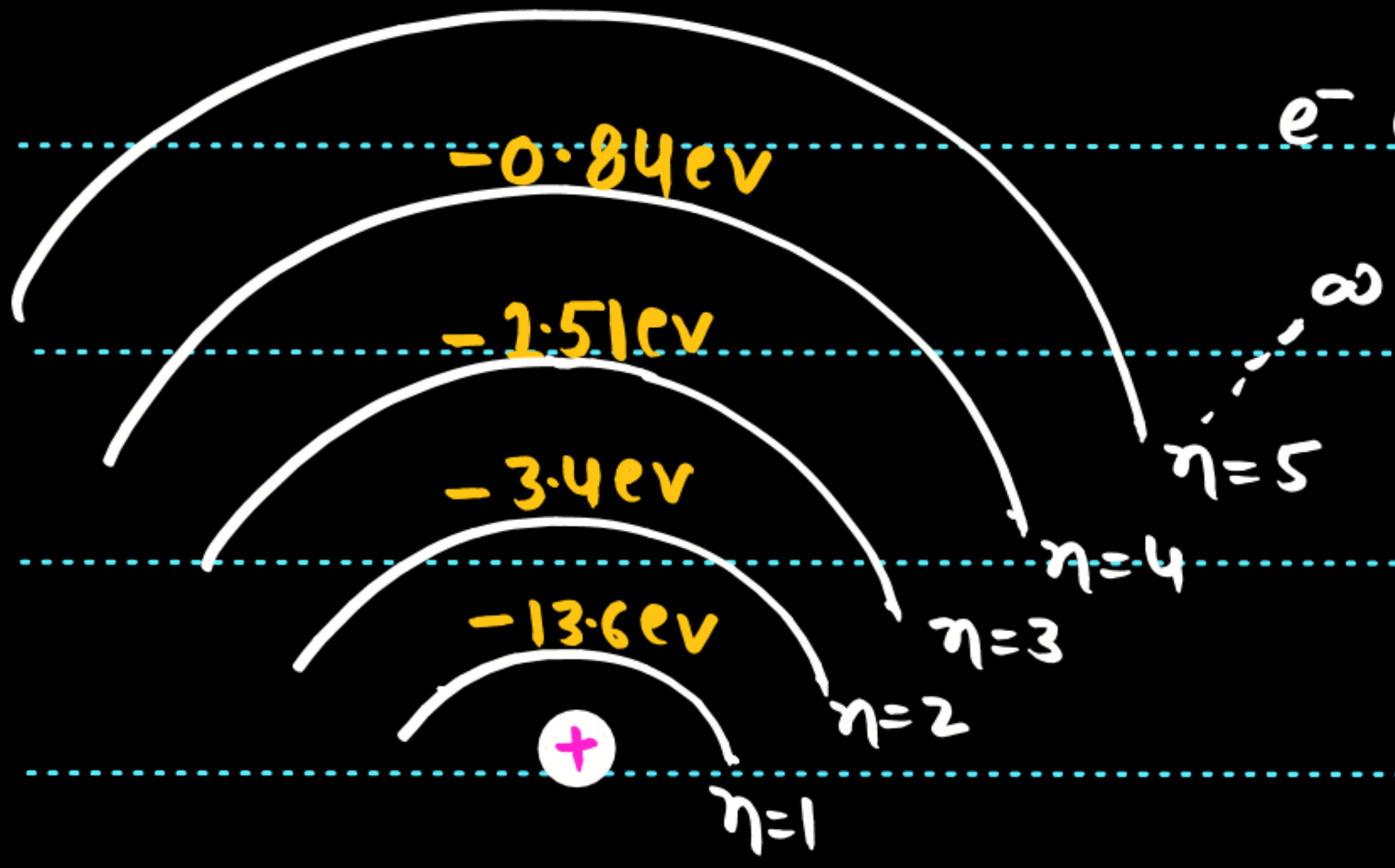
$H \rightarrow Z = 1, n = 2$

$$T.E = -13.6 \times \frac{(1)^2}{(2)^2}$$

$$T.E. = -\frac{13.6}{4} = -3.4 \text{ ev/atom}$$

$$I.E = +3.4 \text{ ev}$$

→ **Quantisation of Energy** = some specific value of revolving e⁻ only possible



$$T.E = -13.6 \times \frac{Z^2}{n^2} \text{ ev/atom}$$

For H-atom ⇒ Z=1

$$T.E = -\frac{13.6}{n^2} \text{ ev/atom}$$ ***

$-\frac{13.6}{9}, -\frac{13.6}{16}$

$n = 1, 2, 3, 4, 5 \ldots\ldots$

Q → Select the correct possible value of total energy for revolving e^- of H-atom

$-\frac{13.6}{n^2}$ ev/atom , $n = 1 \rightarrow -13.6$

$n = 2 = -3.4$

$n = 3 = -1.51$

✗ a) −10.6 ev

✓ b) −3.4 ev

✗ c) −12.2 ev

✗ d) −3.0 ev

Relation b/w T.E, P.E and K.E.

→ $T.E. = \frac{P.E.}{2}$

→ $K.E. = |T.E.|$

→ $K.E. = \left|\frac{P.E.}{2}\right|$

→ $P.E. = -2 \times 13.6 \times \frac{Z^2}{n^2}$ ev/atom

→ $K.E. = +13.6 \times \frac{Z^2}{n^2}$ ev/atom

Q → Calculate Potential energy of 2nd orbit revolving e^- for He^+

a) −13.6 ev

b) −27.2 ev ✓

c) − 3.4 ev

d) NONE

$T.E. = -13.6 \times \frac{Z^2}{n^2}$ ev/atom

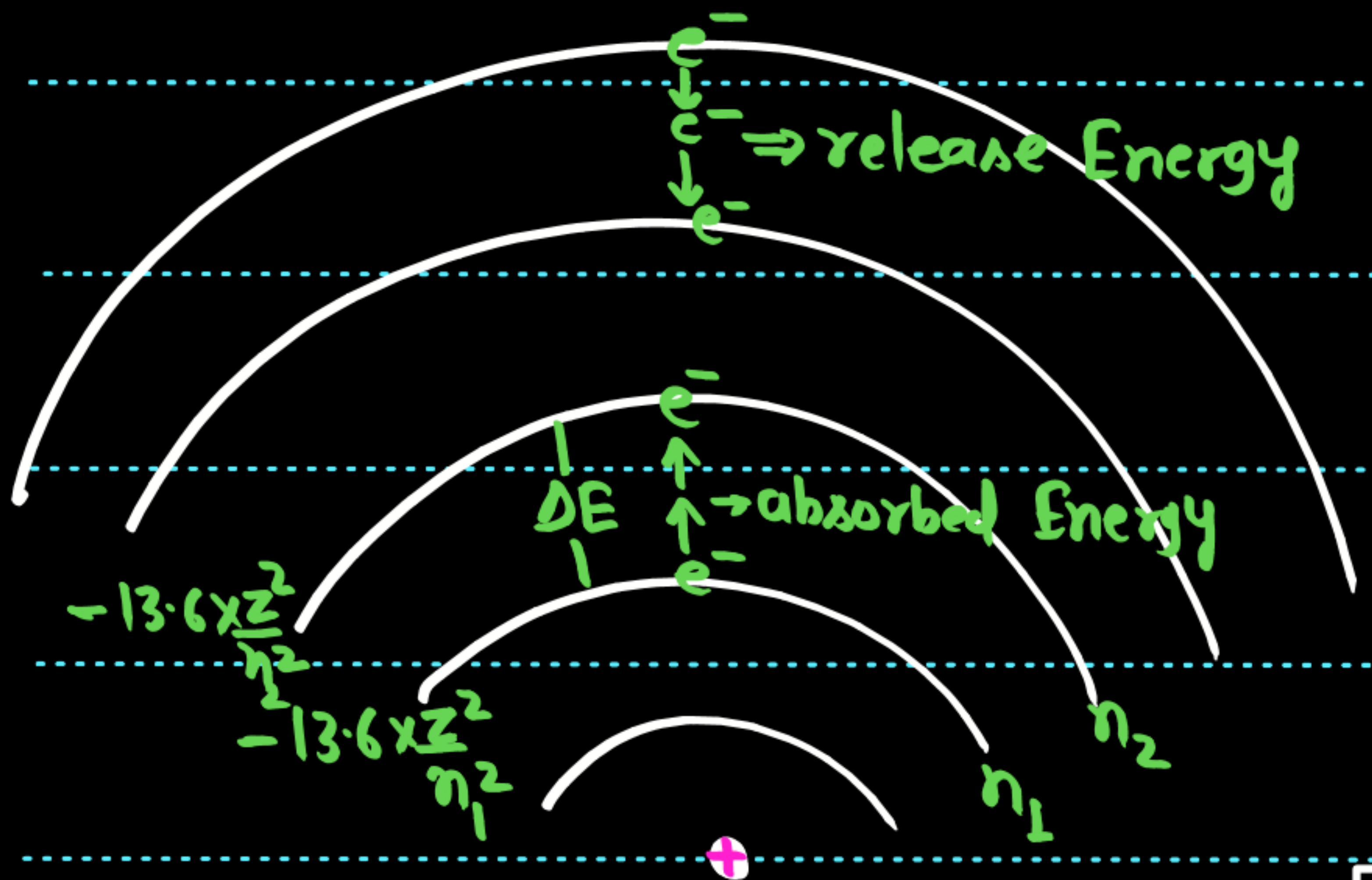
$= -13.6 \times \frac{(2)^2}{(2)^2}$ ev

$T.E. = -13.6$ ev

$P.E. = 2 \times T.E. = -13.6 \times 2$

$= -27.2$ ev

Revolving e⁻ absorbed or release energy, when e⁻ jump / exicted



* upper energy level → lower energy level = Energy release (in term of photon)

* lower energy level → upper Energy level = Energy gain hogi (Absorbed) (in term of photon)

$$\Delta E \propto \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\Delta E = E_{n_2} \sim E_{n_1} = 13.6 \times Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Q → In which transition, the maximum energy photon release

a) $n=4 \rightarrow n=6$ ✗

higher ↓ lower

b) $n=4 \rightarrow n=2 \rightarrow \frac{1}{4}-\frac{1}{16}=\frac{12}{4\times 16}=\frac{3}{16}=0.2$

c) $n=3 \rightarrow n=1 \rightarrow \frac{1}{1}-\frac{1}{9}=\frac{8}{9}=0.9$ ✓

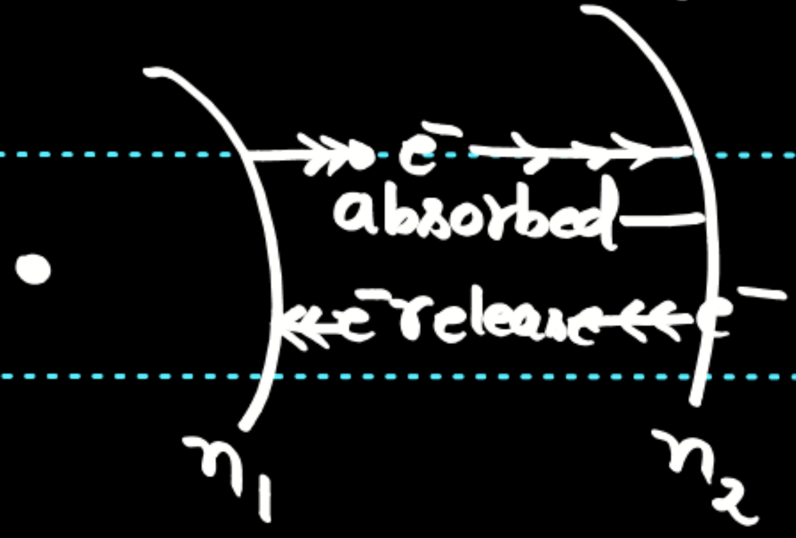
d) $n=1 \rightarrow n=4$ ✗

$$\Delta E \propto \left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

$\underline{\text{Csp}}$ → total Energy of e^- ⇒ T.E. = K.E + P.E. → P.E = 2×T.E.

$T.E. = -13.6 \times \frac{Z^2}{n^2}$ ev/atom → K.E = |T.E.| = $\left|\frac{P.E.}{2}\right|$

→ I.E. = |T.E.|
↓
Ionisation energy

→ 

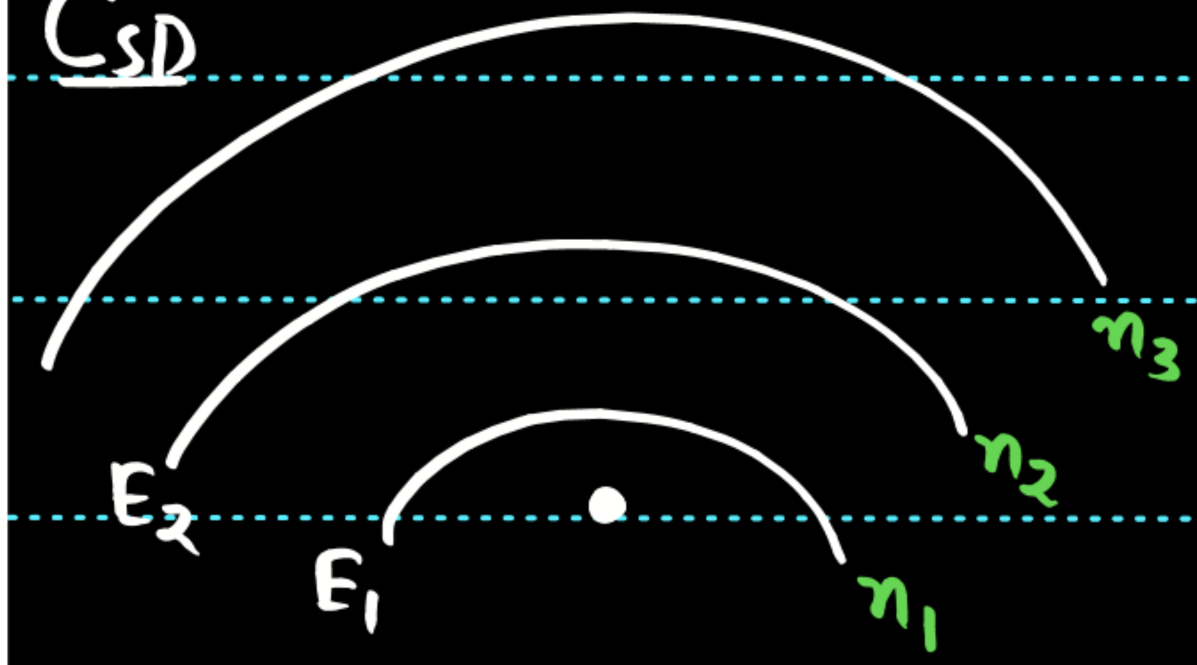
→ The possible value of energy of revolving e^- for H-atom $= -\frac{13.6}{n^2}$ ev/atom

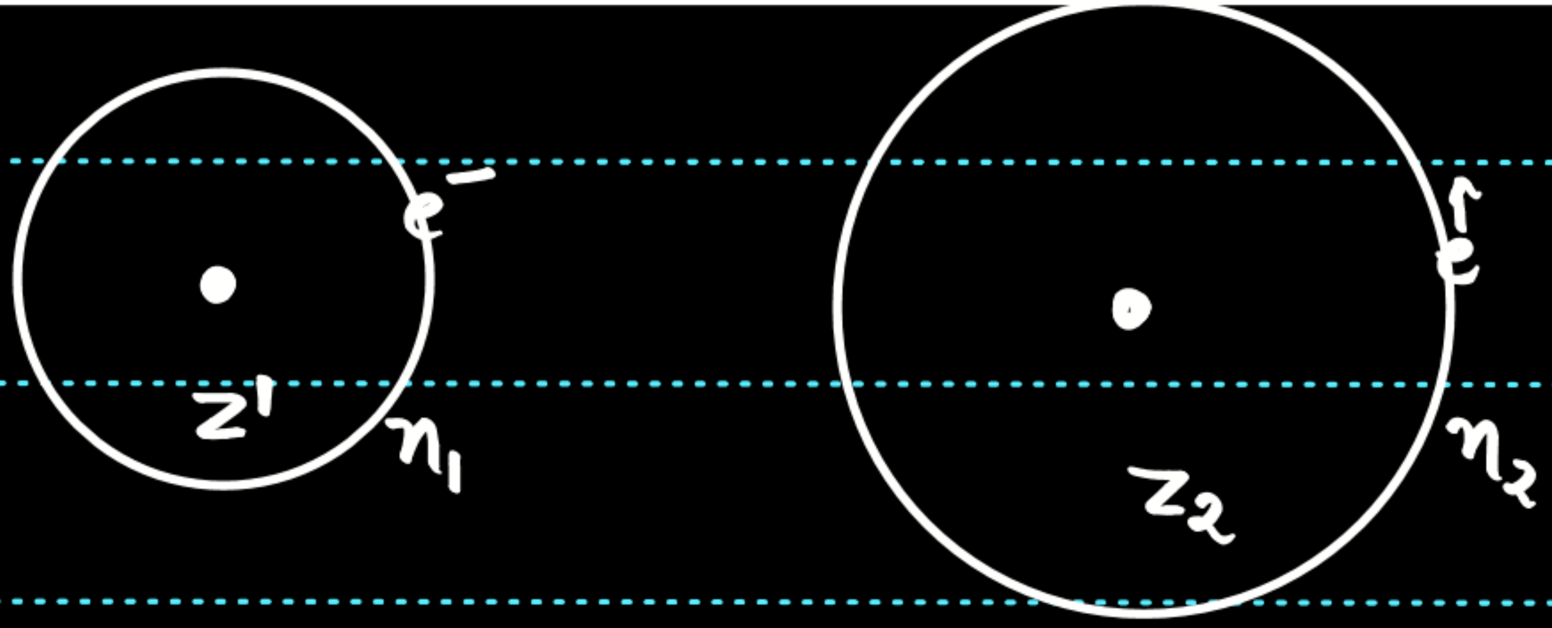
−13.6, −3.4, −1.5, 0.84 - - -

→ $\Delta E = 13.6 \times Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ ev/atom

→ $(\Delta E)_{\text{photon}} \propto \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

CSD





$$E_1 = -13.6 \times \frac{Z^2}{n^2} \text{ ev/atom}$$

$$\boxed{\frac{E_1}{E_2} = \frac{n_2^2}{n_1^2}} \rightarrow E \propto \frac{1}{n^2}$$

$$E \propto \frac{Z^2}{n^2} \rightarrow \boxed{\frac{E_{n_1}}{E_{n_2}} = \left(\frac{Z_1}{Z_2}\right)^2 \times \left(\frac{n_2}{n_1}\right)^2}$$

Q→ total energy of 2^{nd} orbit of H-atom is x eV, Calculate total energy of 5^{th} orbit of e^- for H-atom

✓ a) $-\frac{4x}{25}$

b) $-\frac{25x}{4}$

c) $+\frac{4x}{25}$

d) $+\frac{25x}{4}$

$\frac{E_2}{E_5} = \left(\frac{5}{2}\right)^2 = \frac{25}{4}$

$E \propto \frac{1}{n^2}$

$\frac{x}{E_5} = \frac{25}{4}$

$E_5 = -\frac{4x}{25}$

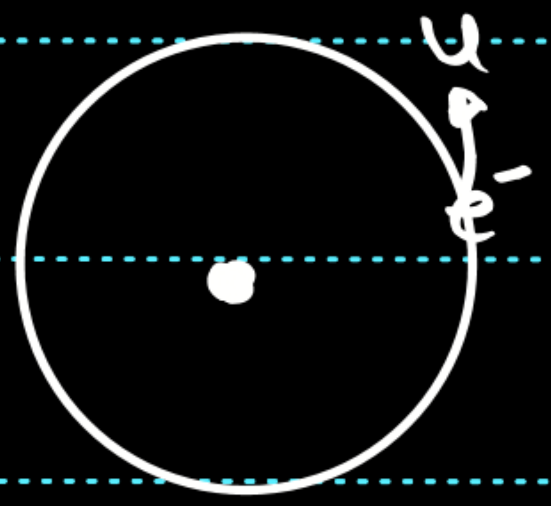
Q→ total energy of 2^{nd} orbit of H-atom is x eV, Calculate total energy o[f] 5^{th} orbit of e^- for He^+ ion

$\frac{E_2}{E_5} = \left(\frac{Z_H}{Z_{He^+}}\right)^2 \times \left(\frac{5}{2}\right)^2$

$\frac{x}{E_5} = \left(\frac{1}{2}\right)^2 \times \frac{25}{4} = \frac{25}{16}$

$E_5 = -\frac{16x}{25}$

Velocity of revolving e^-



$$u = 2.188 \times 10^{+8} \times \frac{Z}{n} \text{ cm/sec}$$

$$u \propto Z, \quad u \propto \frac{1}{n}$$

Q → Velocity of e^- for H-atom is u_1. Calculate velocity of 2nd orbit of Li^{+2} ion

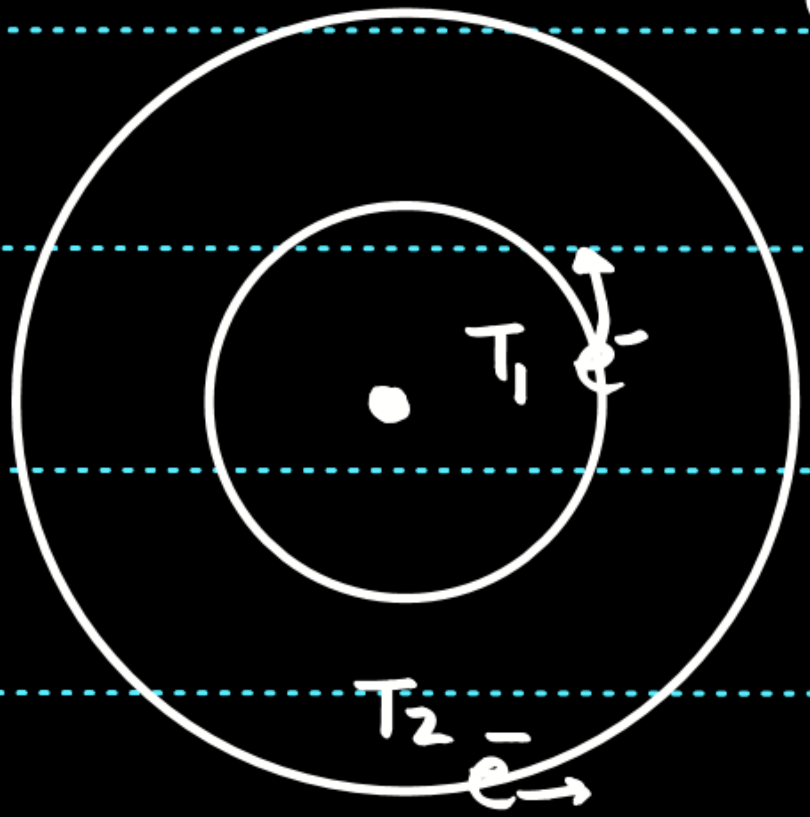
Solⁿ $u_H = 2.188 \times 10^{+8} \times \frac{1}{(1)}$

$u_{Li^{+2}} = 2.188 \times 10^{+8} \times \frac{(3)}{(2)}$

$\frac{u_H}{u_{Li^{+2}}} = \frac{2}{3} \Rightarrow \frac{v}{u_{Li^{+2}}} = \frac{2}{3}$

$u_{Li^{+2}} = \frac{3V}{2}$

Time period = total time req. to Complete one cycle



$$T = 1.5 \times 10^{-16} \frac{n^3}{Z^2} \text{ Sec}$$

Q → Calculate ratio of time req. to complete one cycle in 1st and 3rd orbit of H-atom

a) $\frac{1}{3}$ b) $\frac{1}{9}$ c) $\frac{1}{27}$ ✓ d) NONE

$$T \propto n^3$$

$$\frac{T_1}{T_3} = \left(\frac{1}{3}\right)^3 = \frac{1}{27}$$

de-broglie's wavelength

→ particle = dual character hota hai

1) particle nature

2) wave nature

$$\lambda = \frac{h}{p} = \frac{h}{mu} = \frac{h}{\sqrt{2 \times m \times K.E}}$$

λ → wave nature

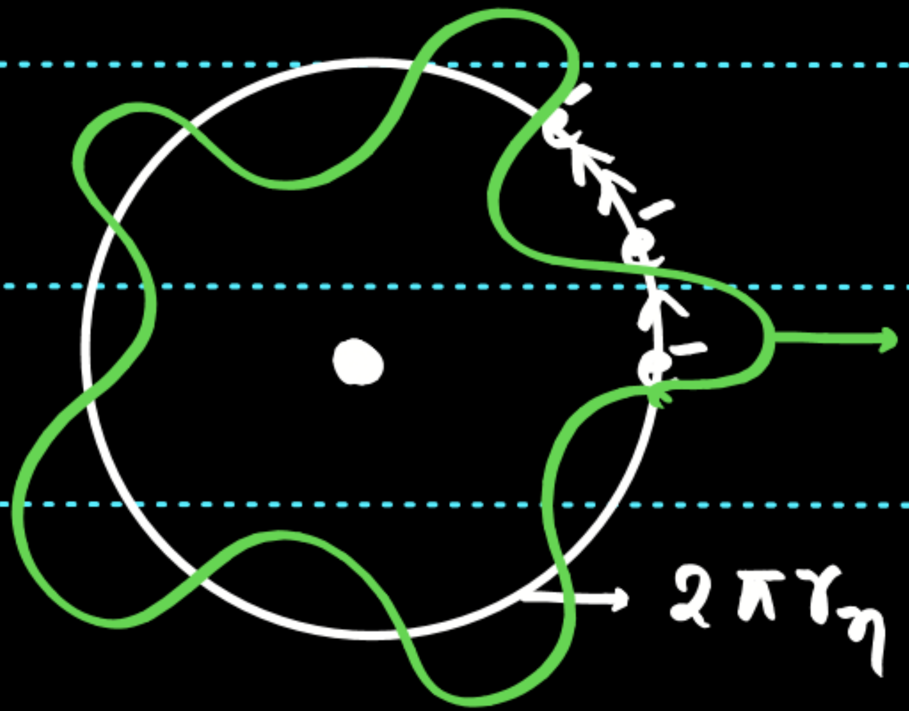
p → particle nature

$$\rightarrow \lambda \propto \frac{1}{m}, \quad \lambda \propto \frac{1}{\sqrt{K.E.}}$$

$$m \times K.E = \frac{1}{2} mu^2 \times m$$

$$2 \times m \times K.E = m^2 u^2$$

$$mu = \sqrt{2 \times m \times K.E.}$$



$$n \times \lambda = 2\pi r_n$$

→ n = orbit No.

→ r_n = radius of n^{th} orbit

* No. of wave to complete one cycle = No. of orbit

Q→ How many wavelength req. to complete one cycle of 3rd orbit of H-atom

a) 1 b) 2 c) 3 d) 4

Q → radius of 2nd orbit of H-atom is x A°

Calculate de-broglie's wavelength for 2nd orbit of H-atom.

a) πx ✓

b) $2\pi x$

c) $4\pi x$

d) $\frac{\pi x}{2}$

$$n \times \lambda = 2\pi r_n$$

$$\cancel{2} \times \lambda = \cancel{2}\pi r_2$$

$$\lambda = \pi x$$

Q → particle | K.E. | mass

particle	K.E.	mass
A	E_1	$4m$
B	E_2	m

$E_2 = 2E_1$, than arrange debroglie's wavelength order

a) $\lambda_A = \lambda_B$ b) $\lambda_A > \lambda_B$

c) $\lambda_A < \lambda_B$ ✓

d) NONE

$$\lambda_A = \frac{h}{\sqrt{2 \times 4m \times E_1}}$$

$$\lambda_B = \frac{h}{\sqrt{2 \times m \times E_2}}$$

$$\frac{\lambda_A}{\lambda_B} = \frac{\sqrt{2 \times m \times 2E_1}}{\sqrt{2 \times 4 \times m \times E_1}}$$

$$\frac{\lambda_A}{\lambda_B} = \frac{1}{\sqrt{2}}, \quad \lambda_B = \sqrt{2} \times \lambda_A$$

SANKALP NEET VEDANTU

MANTHAN NEET 2025

CHEMISTRY

ATOMIC STRUCUTURE

Lecture-06



Sarvesh Sir

Revision plan

→ Chapterwise Revision	→ Class per week – Extra class
→ theory → Revision	Chapterwise → theory + Question = 100Q
→ Numerical practice	→ test = App or telegram (mere)
→ test chapterwise	→ Sarveshdixitcsd official → telegram
	Anskey + Solution

Qsc

The shortest wavelength of H atom in the Lyman series is λ_1. The longest wavelength in the Balmar series of He is

A $\frac{5\lambda_1}{9}$

B $\frac{36\lambda_1}{5}$

C $\frac{27\lambda_1}{5}$

D $\frac{9\lambda_1}{5}$

$\Delta E = \frac{hc}{\lambda} \rightarrow \uparrow \Delta E \propto \frac{1}{\lambda}$ (max; λ shotest)

$n_2 = \infty$

$n_2 = 3$

$\frac{1}{\lambda_1} = R(1)^2\left(\frac{1}{1^2} - \frac{1}{\infty}\right)$

$\frac{1}{\lambda} = R(2)^2\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

$\frac{\lambda}{\lambda_1} = \frac{9 \times 4}{4 \times (9-4)}$

$\lambda = \frac{9\lambda_1}{5}$

Qsd-2 How many wavelength required to Complete one cycle of 3rd orbit of H-atom

a) 2

b) 3

c) 4

d) 1



Heisenberg uncertainty principle

position and momentum of any particle does not measure 100% correct at a time
(Efficiency)

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

Δx = Uncertainty in position

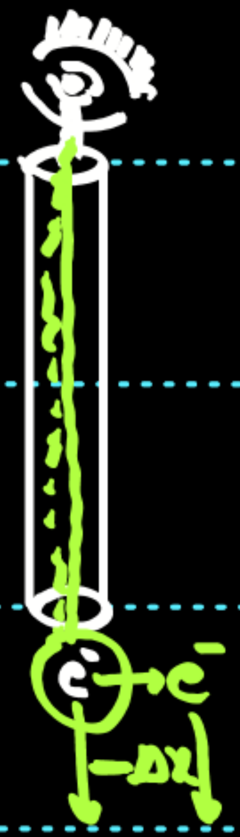
Δp = Uncertainty in momentum

$x \times y = 100$

50×2

100×1

$200 \times \frac{1}{2}$



$\Delta p = m\Delta v$

$$\Delta x \times m\Delta v \geq \frac{h}{4\pi}$$

$$\boxed{\Delta x \times \Delta v \geq \frac{h}{4\pi m}}$$

Minimum uncertainty → $\Delta x \times \Delta p = \frac{h}{4\pi}$

$$\Delta x \times \Delta v = \frac{h}{4\pi m}$$

Q→ Calculate uncertainty value $\Delta x \times \Delta v$ for electron

a) $\frac{h}{4\pi \times 1.6 \times 10^{-19}}$

$\Delta x \times \Delta v = ?$

$\Delta x \times \Delta v = \frac{h}{4\pi m} = \frac{h}{4\pi \times 9.1 \times 10^{-28} \text{gram}}$

b) $\frac{h}{4\pi}$

✓ c) $\frac{h}{4\pi \times 9.1 \times 10^{-28}}$

d) NONE

Q → If uncertainty of position and momentum are equal than calculate uncertainty in velocity

a) $\frac{h}{4\pi m}$

b) $\sqrt{\frac{h}{4\pi}}$

✓(c) $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$

(d) NONE

$\Delta x = \Delta p$, $\Delta V = ?$

$\Delta x \times \Delta p = \frac{h}{4\pi}$

$\Delta p \times \Delta p = \frac{h}{4\pi}$

$\Delta p^2 = \frac{h}{4\pi} \Rightarrow (m\Delta v)^2 = \frac{h}{4\pi}$

$m\Delta v = \sqrt{\frac{h}{4\pi}}$

$\Delta V = \frac{1}{2m}\sqrt{\frac{h}{\pi}}$

13:3

CSD → $\Delta x \times \Delta p \geq \frac{h}{4\pi}$

→ $\Delta x \times \Delta v \geq \frac{h}{4\pi m}$

→ minimum uncertainty → $\Delta x \times \Delta p = \frac{h}{4\pi}$

Schrodinger wave Equation

→ 8.00pm → Half NEET → Live

→ thermodynamics → theory Revision Questionwise
+
Numerical Question

→ 2.30-3.00hr → Lecture

$e^- \to$ suppose $\to$ particle nature base

Schrodinger $\to$ $e^- \to$ suppose = wave nature base = model

$e^- \to$ wave

$$\psi = a \sin \omega t$$

$$x^2 - 4 = 0$$

$$x^2 = 4$$

further solve above equation and form No. of value of ψ. but only some value selected = Eegin value

length $\leftarrow$ $x = \pm 2$

$x = +2$

$x = (-2)^2 = 4$

$x = (+2)^2 = 4$

and related function (Equation) is known Eegin function

$\psi = a \sin \omega t$

$x^2 - 2x = 0$

$x(x-2) = 0$, $x = 0$, $x = +2$

↓

Radial wave function

$f(r) \rightarrow$

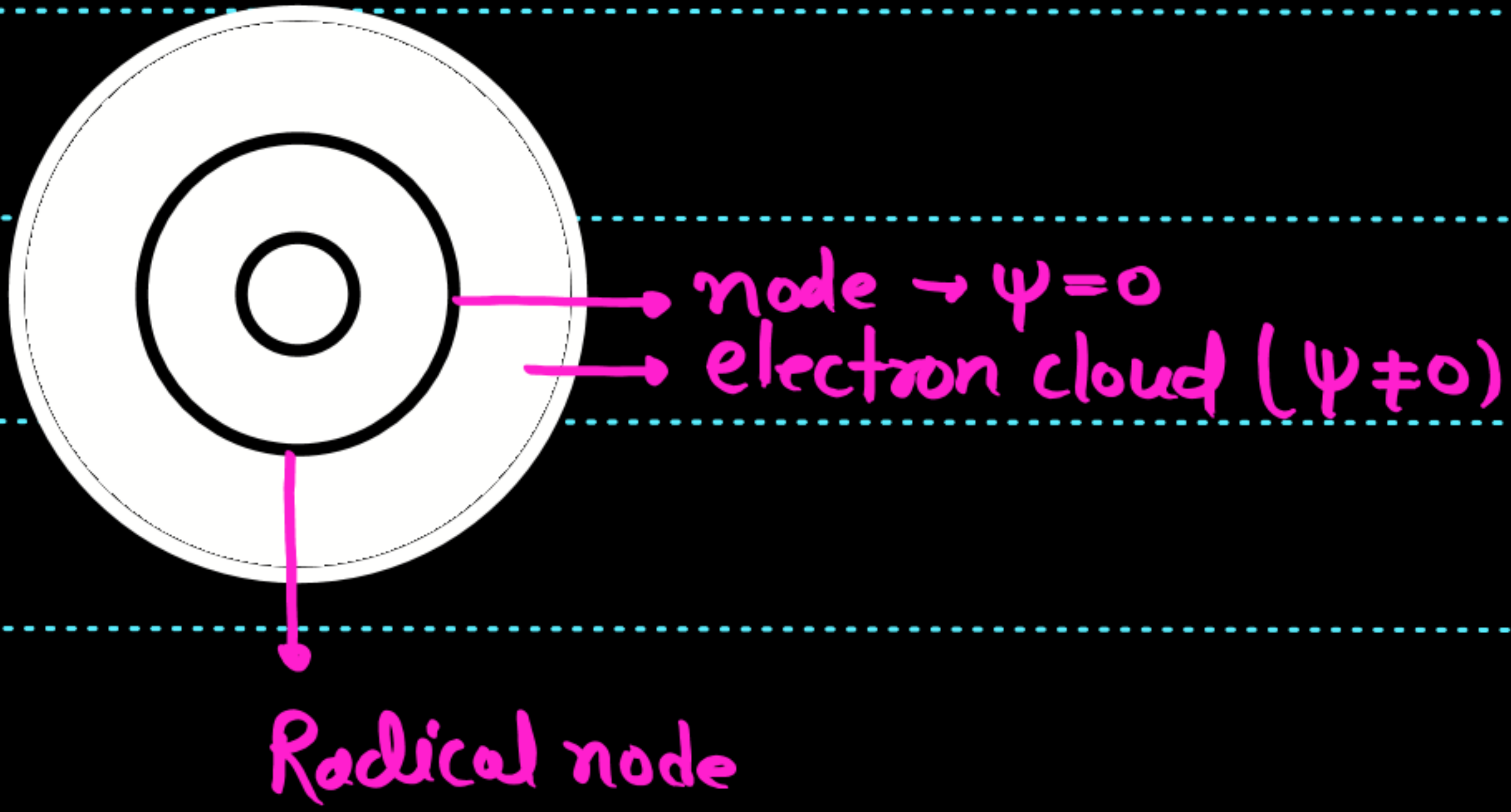
- $\psi \neq 0$
- $\psi = 0$
  ↓
  NODE → e^- cloud does not present
  ↓
  Radial node = $n - l - 1$
  or
  Spherical node → within the orbital

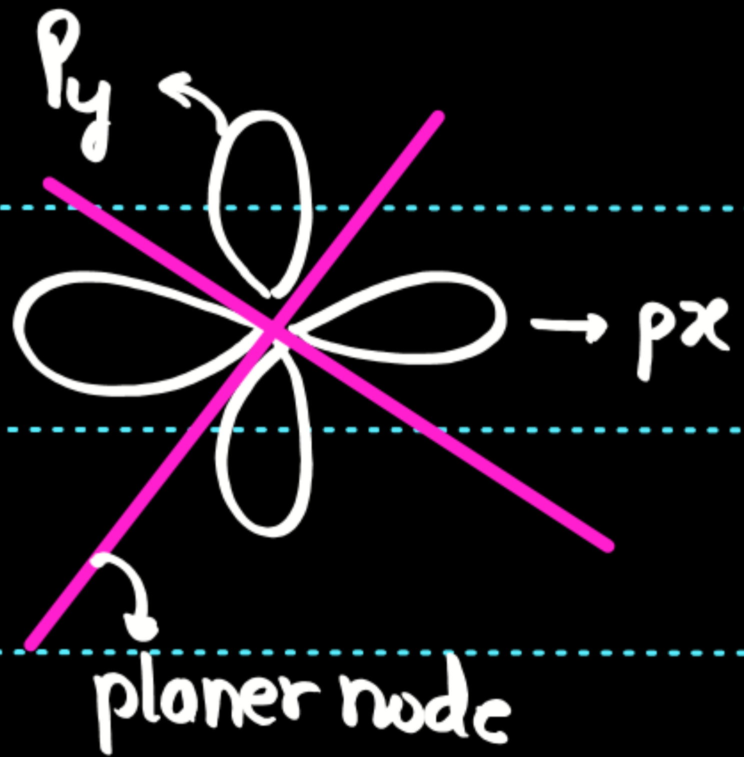
Angular wave Equation

$f(\theta, \phi)$

↓

- $\psi \neq 0$
- $\psi = 0$
  ↓
  NODE = Angular node
  or
  planer node $= l$
  between the orbital





→ Quantum Number is a solution Schrodinger wave equation

→ 1) principle quantum No. 2) Azimuthal Q.No. 3) Magnetic Q.No.

Principle Quantum Number (n)

$n = 1, 2, 3, 4 ---$

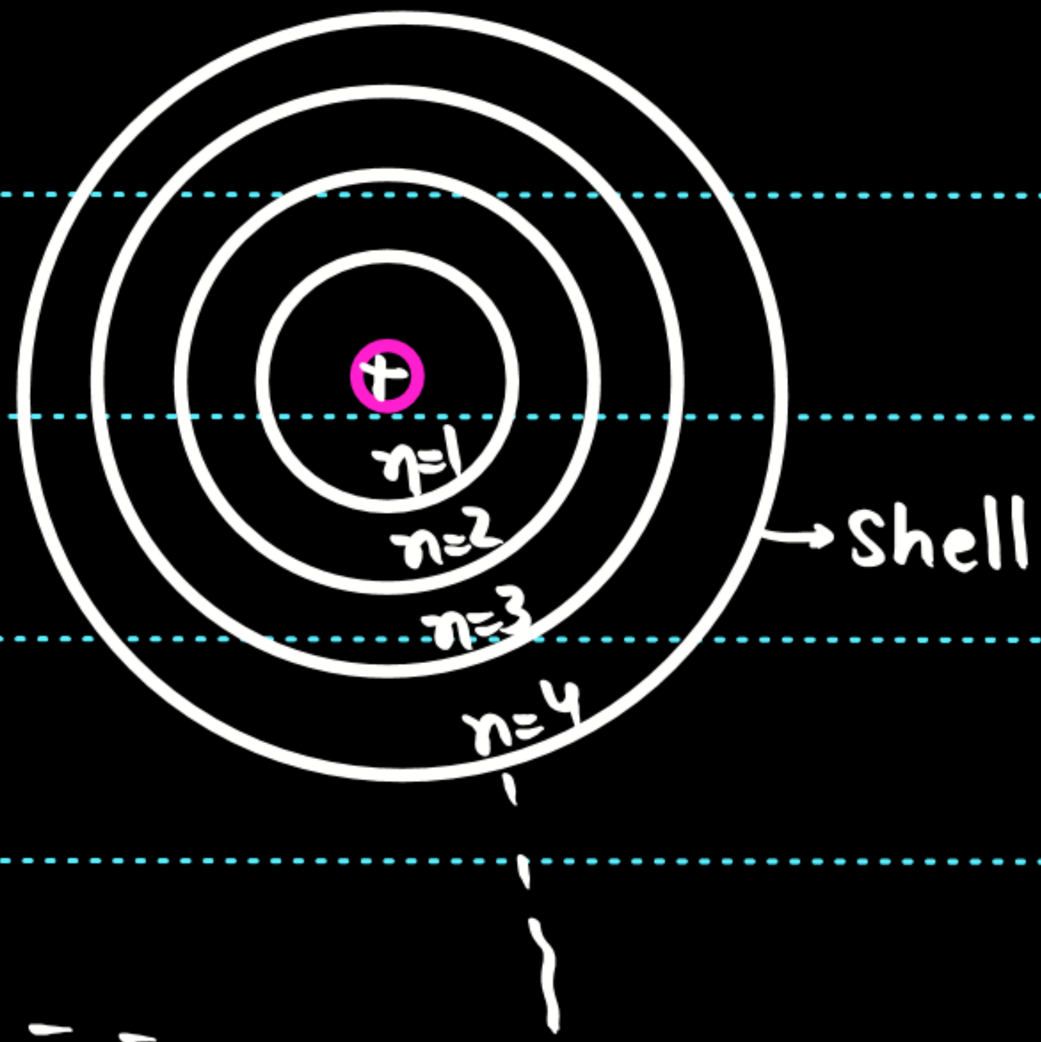
$n \neq 0$, $n \neq$ fractional, negative

→ Similar to Bohr's orbit number

→ Represent → n = Shell = 1, 2, 3, 4 ----

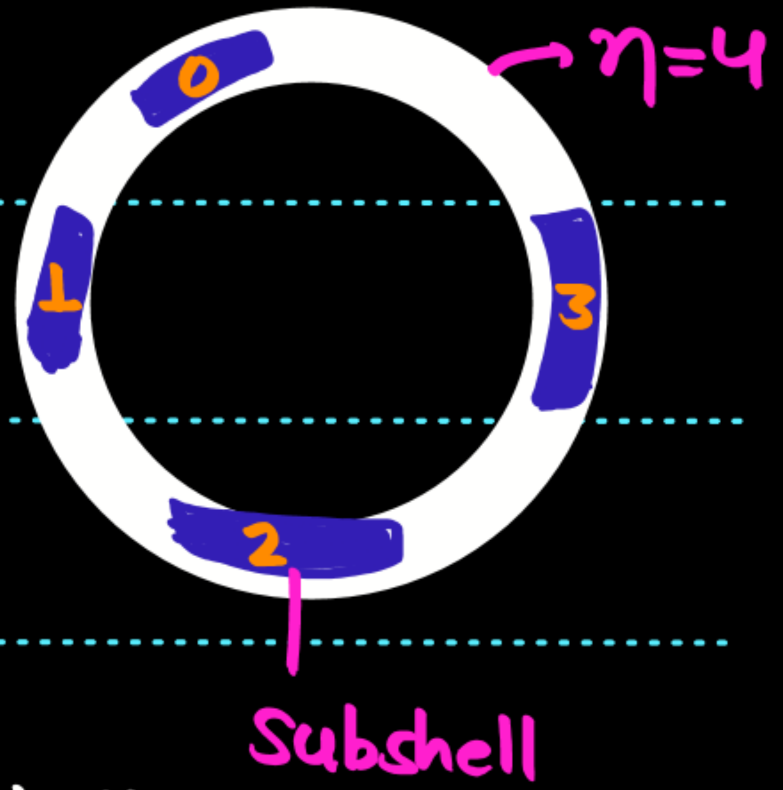
→ Size of atom, Energy of atom

$n = 1 (K), 2 (L), 3 (M), 4 (N), ----$



Azimuthal Quantum Number (l)

Represent → l



$\boxed{l \to 0 \text{ to } (n-1)} \to \boxed{n > l}$ (alway) → $l_{max} = n-1$

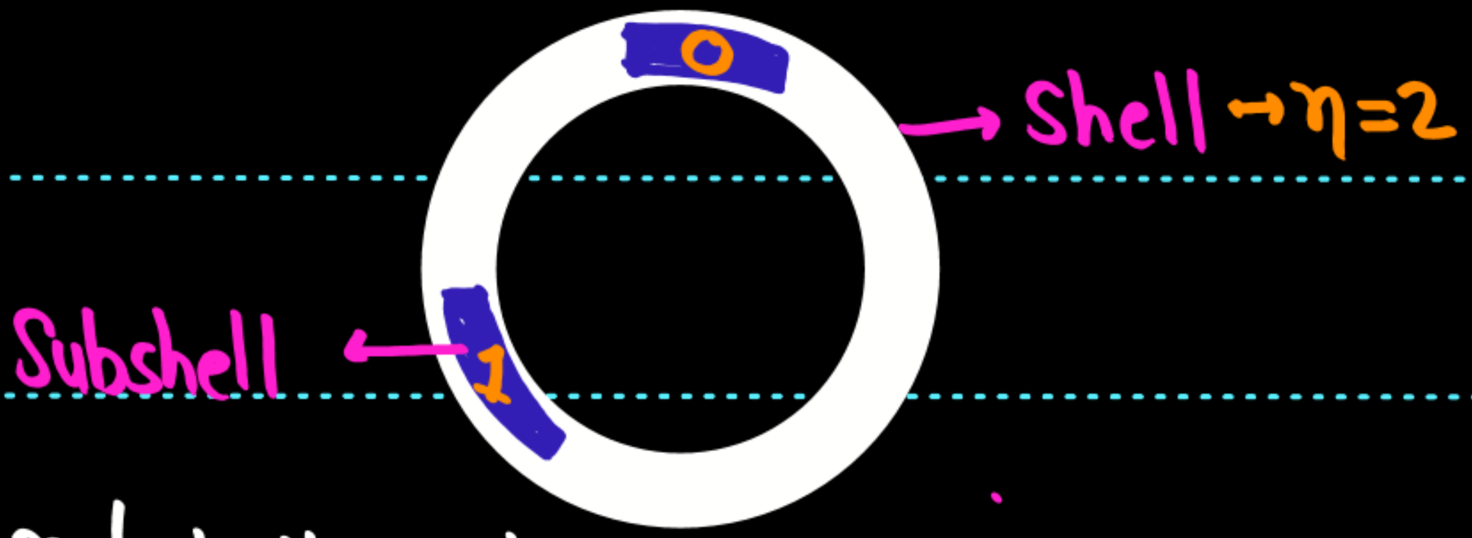
$l_{min} = 0$

$n = 2$

$l = 0, 1$

* l → Represent = Subshell

$n = 3 \to l = 0, 1, 2$



$n = 4 \to l = 0, 1, 2, 3$

total value of 'l' for given shell = n (shell number)

Value of l	name of Subshell
l = 0 →	s-subshell
l = 1 →	p-subshell
l = 2 →	d-subshell
l = 3 →	f-subshell
l = 4 →	g-subshell
l = 5 →	h-subshell

Q → findout value of l in given subshell

p-subshell → l = 1

d-subshell → l = 2

s-subshell → l = 0

g-subshell → l = 4

No. of shell	No. of subshell in given shell = n ⇒ $l = 0$ to $(n-1)$
$n = 1$	= ① → $l = 0$ → s-subshell
$n = 2$	= ② → $l = 0, 1$ ⇒ s-subshell, p-subshell
$n = 3$	= ③ → $l = 0, 1, 2$ ⇒ s-subshell, p-subshell, d-subshell
$n = 4$	= ④ $l = 0, 1, 2, 3$ ⇒ s, p, d and f-subshell
$n = 5$	= ⑤ $l = 0, 1, 2, 3, 4$ ⇒ s, p, d, f and g-subshell

Q-1 How many total value of l in $n=3$ shell

a) 1   b) 2   c) 3 ✓   d) 4

Q-2 → which subshell in not possible in given $n=3$ shell → $l = 0, 1, 2$

a) s-subshell   b) p-subshell   c) d-subshell   d) f-subshell ✓

Q-3 → Which value of 'l' not possible for $n=5$ shell → $l < n$ → alway

a) $l=2$ b) $l=4$ c) $l=5$ ✗   d) $l=0$

Magnetic Quantum Number

Represent → m or m_l or m_s

Value of m → $-l$ to $+l$ or $+l$ to $-l$

→ $l \geq |m|$ → $(m)_{max} = +l$, $(m)_{min} = -l$

→ $l = 0$ → $m = 0$

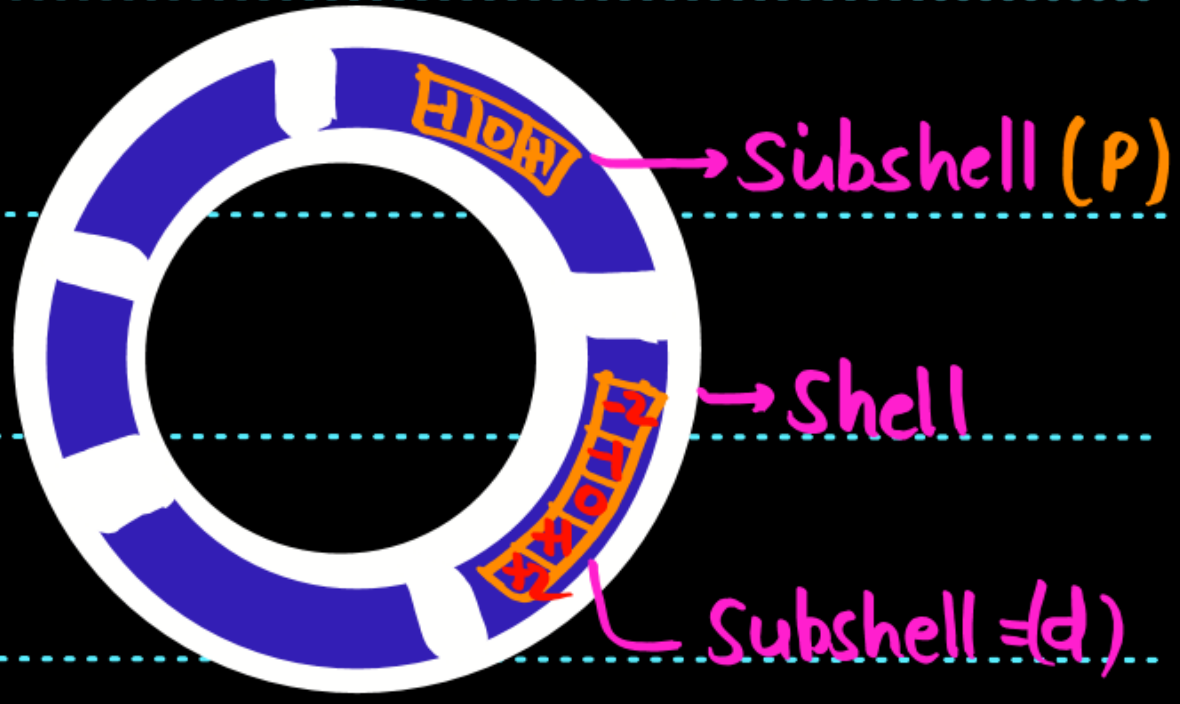
$l = 1$ → $-1, 0, +1$

p-subshell

$l = 2$ → $-2, -1, 0, +1, +2$

* Orientation of orbital (3D)

m = orbital



* orbital = 90-95% probability of finding e^- cloud

THANK YOU
All the Best!! 👍

MANTHAN NEET 2025

CHEMISTRY

ATOMIC STRUCUTURE

Lecture-07



Sarvesh Sir

Revision plan

- → Chapterwise Revision
- → theory → Revision
- → Numerical practice
- → test chapterwise
- → Weekly class → 70-100 Questⁿ

  test = 20 Questⁿ → telegram

  Sarveshdixitcsd official

- → Class per week – Extra class

  Chapterwise → theory + Question = 100Q

- → test = App or telegram (mere)

  → Sarveshdixitcsd official → telegram

  Anskey + Solution

- → **Sunday → 3:00pm – 5:00pm**

Q. How many subshell present in 3rd shell

A 1

B 2

C 3 ✓

D 4

No. of subshell = value of n = 3

$n = 3$

$l = 0$ to $(n-1)$

0, 1, 2

s, p, d.

Q. How many orbital present in 2^{nd} shell

A 1

B 2

C 3

D 4 ✓

No. of orbital $= n^2 = (2)^2 = 4$

$n = 2$

$l = 0, 1$

$m = \boxed{0} \quad \boxed{-1}\boxed{0}\boxed{+1}$

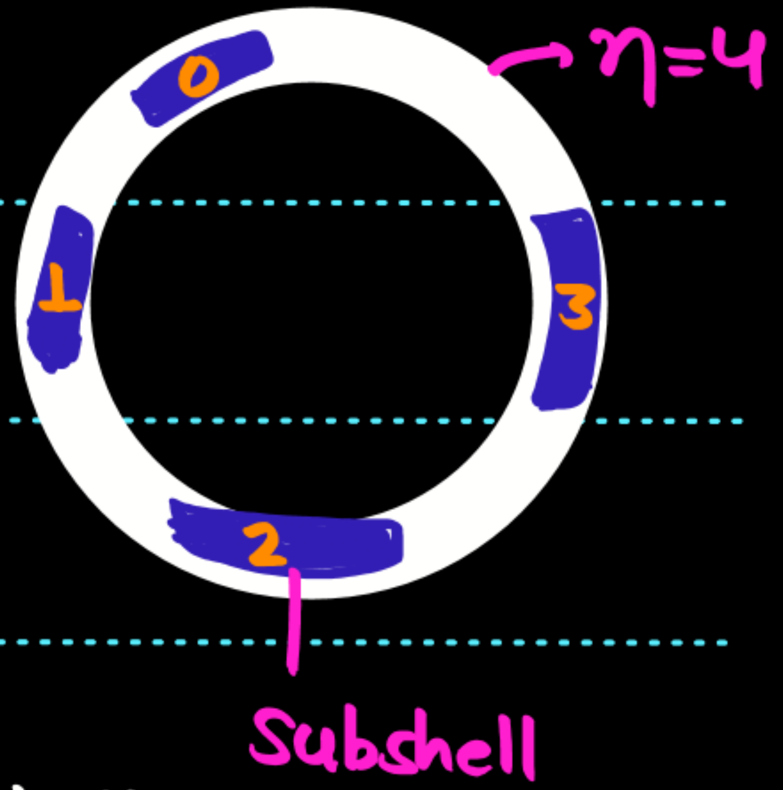
$\frac{?}{2}$

Azimuthal Quantum Number (l)

Represent → l

$l \rightarrow 0$ to $(n-1)$ → $n > l$ (alway) → $l_{max} = n-1$

$l_{min} = 0$



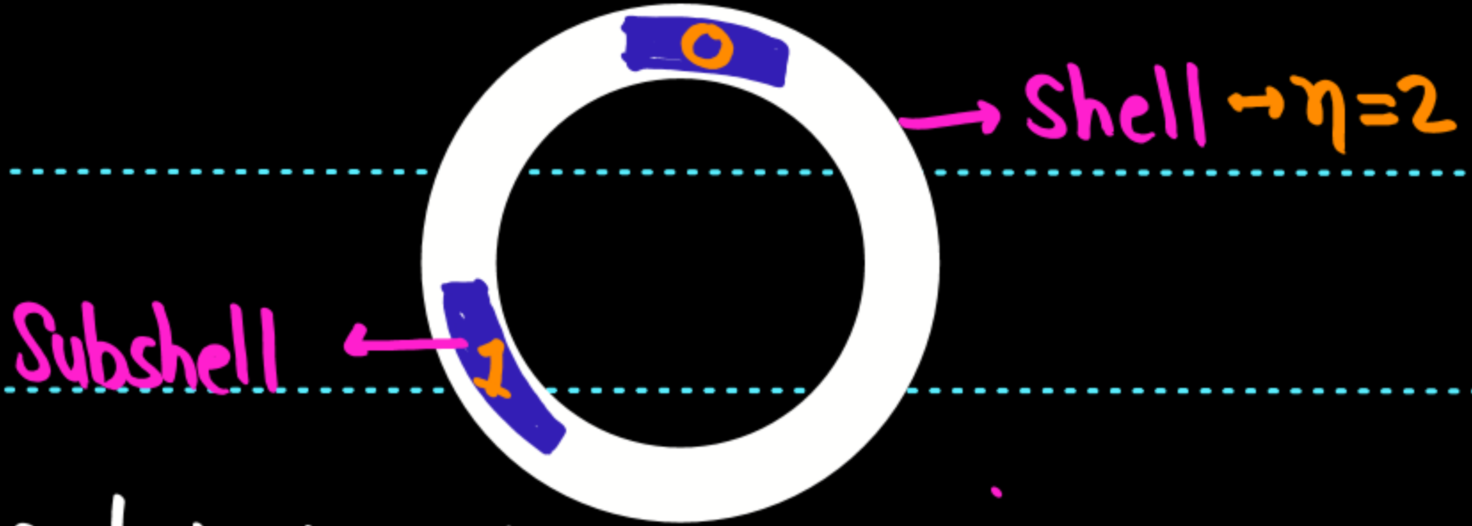
$n = 2$

$l = 0, 1$

* l → Represent = Subshell

$n = 3 \rightarrow l = 0, 1, 2$

$n = 4 \rightarrow l = 0, 1, 2, 3$



total value of 'l' for given shell = n (shell number)

Magnetic Quantum Number

Represent → m or m_l or m_s

value of m → $-l$ to $+l$ or $+l$ to $-l$

→ **$l \geq |m|$** → $(m)_{max} = +l$, $(m)_{min} = -l$

→ $l = 0$ → $m = 0$ → 'm' value $= (2l+1)$

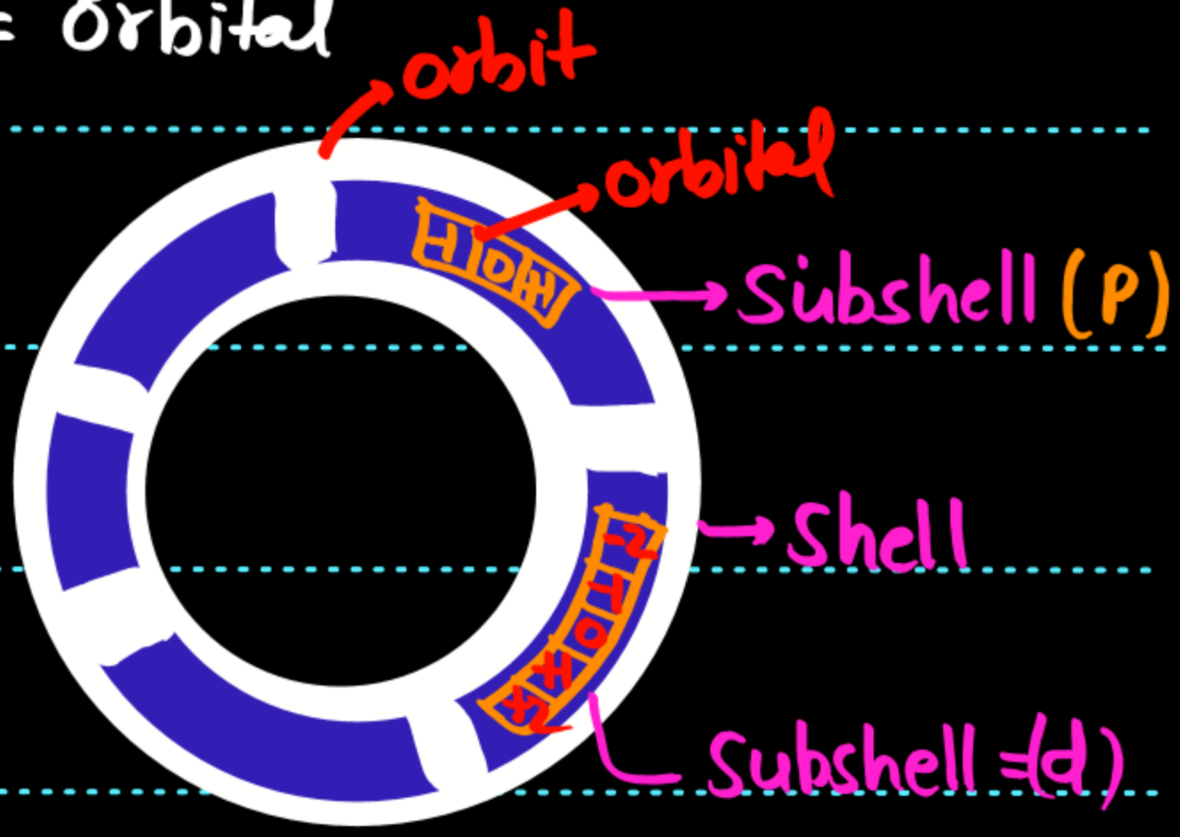
$l = 1$ → $-1, 0, +1$

p-subshell

$l = 2$ → $-2, -1, 0, +1, +2$

* Orientation of orbital (3D)

m = orbital



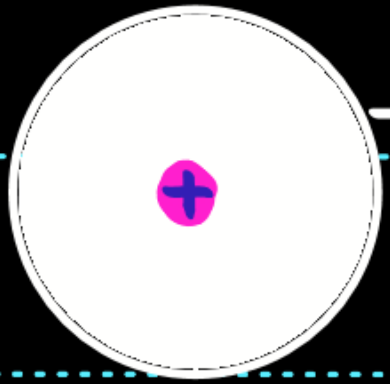
* orbital = 90-95% probability of finding e^- cloud

No. of orbital $(m) = (2l+1) = n^2$

No. of e^- $= 2(2l+1) = 2n^2$

$l = 0 \rightarrow$ s-subshell

$m = 0 \rightarrow$ □ $\rightarrow$ s-orbital



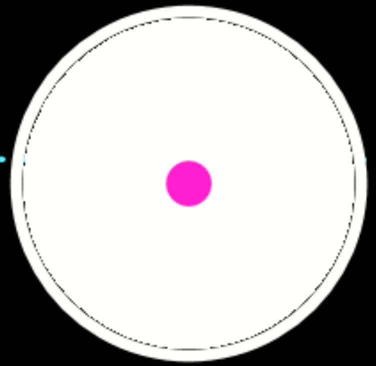
→ s-orbital

→ spherical shape

R. node

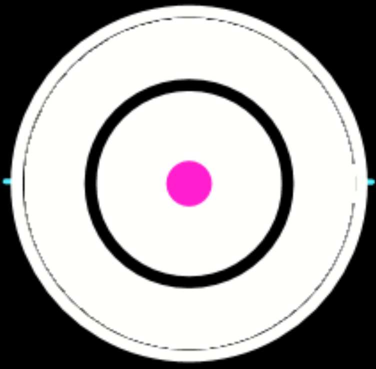
$n - l - 1$

1s



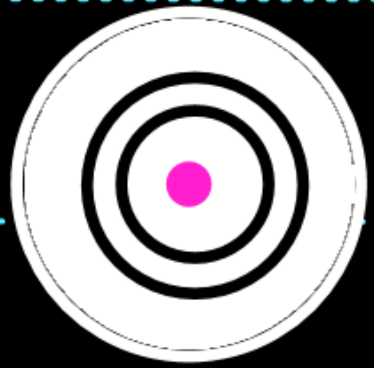
$1-0-1=0$

2s



$2-0-1=1$

3s



$3-0-1=2$

$l = 1 \rightarrow$ p-subshell

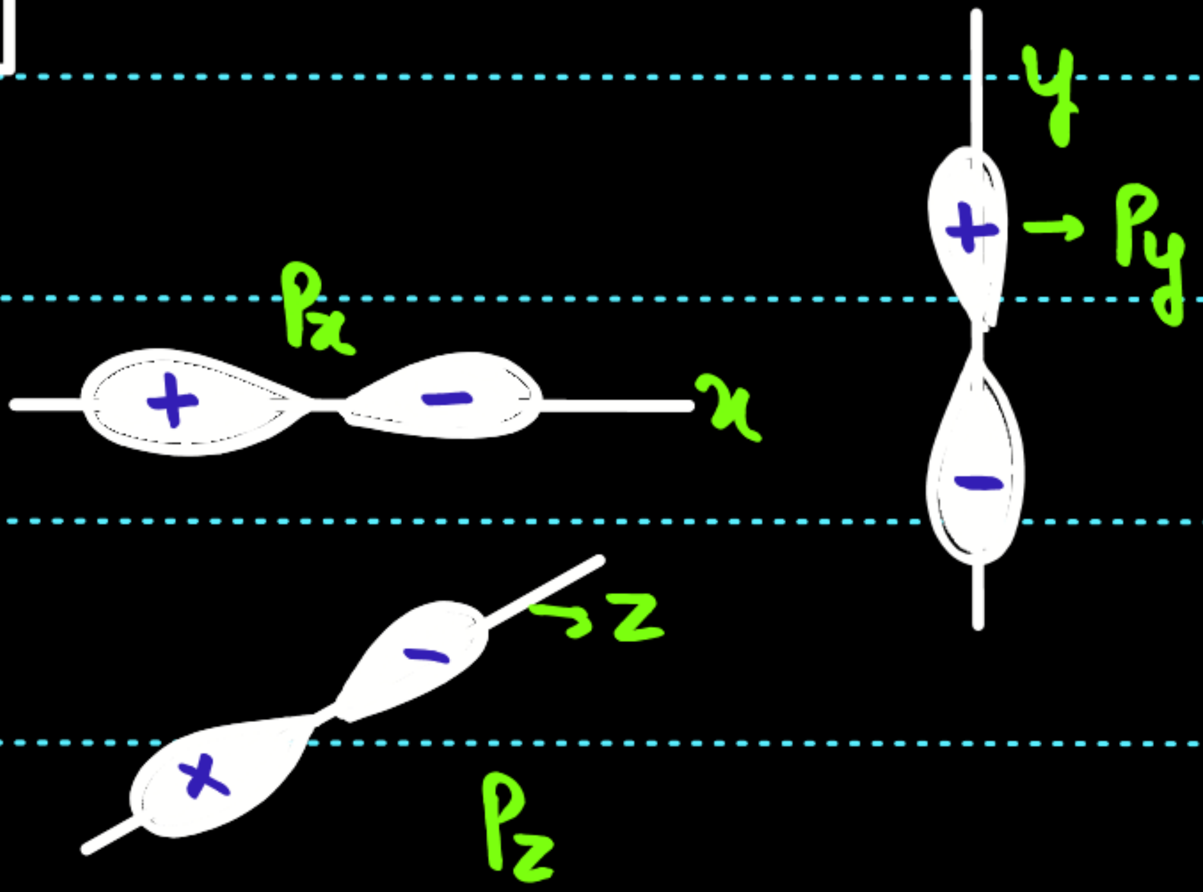
$m = -1, 0, +1$

-1	0	$+1$

P_x or $P_y = \pm 1$

$P_z = 0$





$l = 2$ - d-subshell

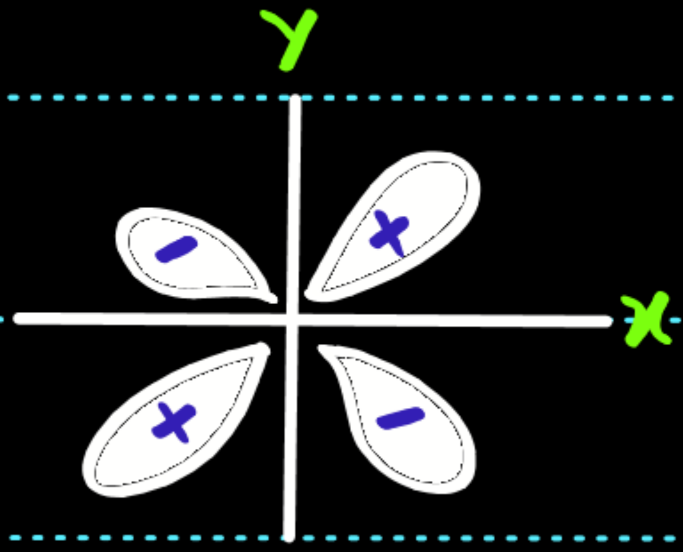
$m = -2, -1, 0, +1, +2$

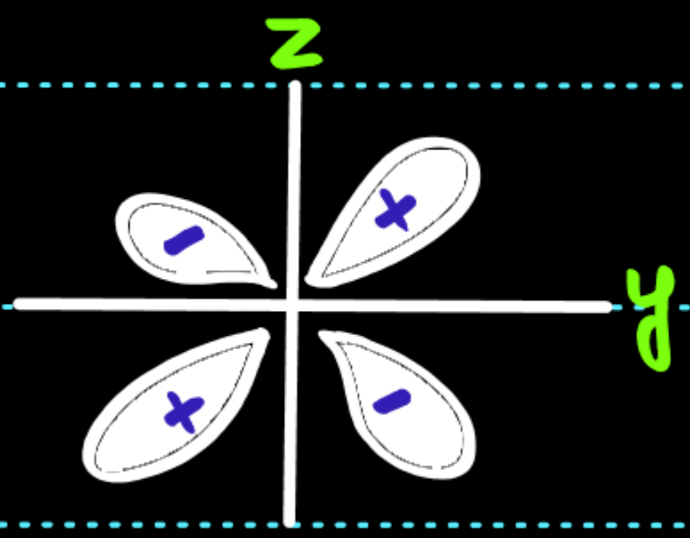
-2	-1	0	$+1$	$+2$

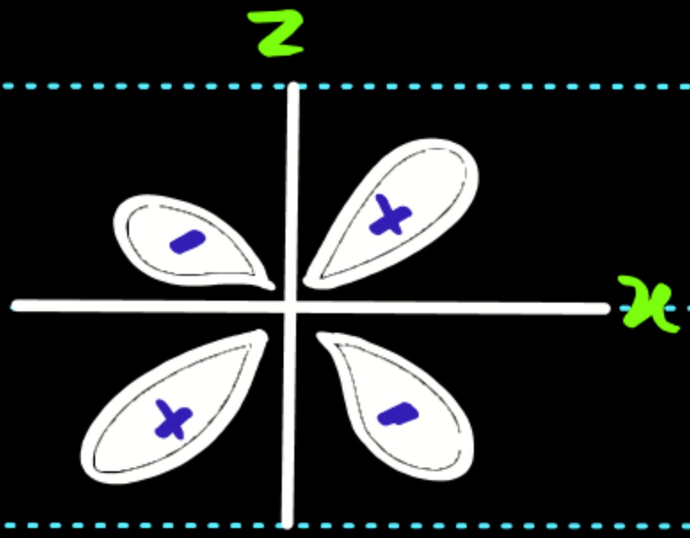
$d_{z^2} = 0$

d_{xy} or $d_{yz} = \pm 1$

$d_{x^2-y^2}$ or $d_{xz} = \pm 2$







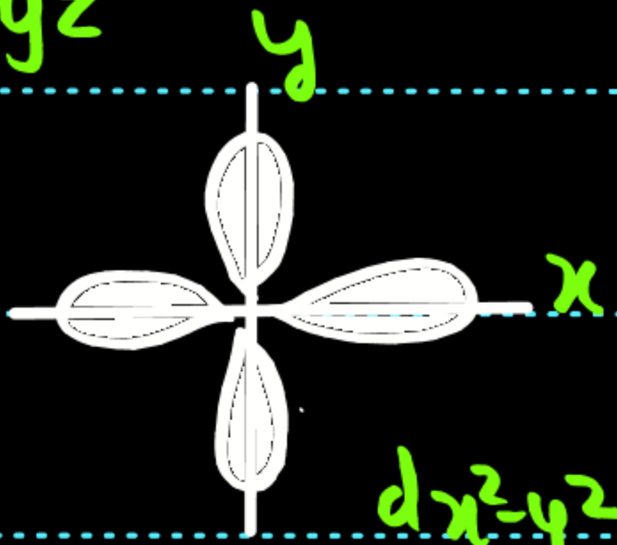
= plane orbital

dxy　　dyz　　dxz

Axis-orbital



→ dz^2



dx^2-y^2

Spin Quantum No:

It is not a solution of Schrodinger wave Eq.

$s = [\uparrow] \rightarrow +\frac{1}{2}$

$s = [\downarrow] \rightarrow -\frac{1}{2}$

Q → $n = 1 \rightarrow 1^{st}$ shell

$l = 0 \rightarrow$ s-subshell

$m = 0 \rightarrow$ s-orbital

$s = \pm\frac{1}{2}$ [↑↓]

Q → $n = 2 \rightarrow 2^{nd}$ shell

$l = 0, 1 \rightarrow$ s and p-subshell

$l = 0 \rightarrow m = 0 \rightarrow$ [↑↓]

$l = 1 \rightarrow m = -1, 0, +1 \rightarrow$ [↑↓|↑↓|↑↓] (−1, 0, +1)

C_{SD}

1 → $n > l$ → $l = 0$ to $(n-1)$ → $l_{max} = n-1$

2 → $l \geq |m|$ → $m = -l$ to $+l$ → $m_{max} = +l$

Orbit angular momentum
or
Angular momentum of orbit $= n \times \frac{h}{2\pi}$

Orbit → shell

Orbital → 90-95% → highest probability

Type of Angular momentum

Orbital angular momentum $(L) = \sqrt{l(l+1)}\,\frac{h}{2\pi}$ or $\sqrt{l(l+1)}\,\hbar$

Spin angular momentum $(S) = \sqrt{s(s+1)}\,\frac{h}{2\pi}$ or $\sqrt{s(s+1)}\,\hbar$

Mangnetic moment of e^- → $\mu_m = \sqrt{n(n+2)}$ B.M → n = No. of unpaired e^-

Q → 2p-subshell

orbital angular momentum

Sol^n $L=\sqrt{l(l+1)}\,\hbar$

$L=\sqrt{1\times 2}\,\hbar$

$=\sqrt{2}\,\hbar$

Q → $2p^3$-subshell

Calculate spin angular momentum of e^-

[↑] [↑] [↑]

$+\frac{1}{2}$ $+\frac{1}{2}$ $+\frac{1}{2}$

$s=+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}=3/2$

$S=\sqrt{s(s+1)}\,\hbar$

$=\sqrt{\frac{3}{2}\times\frac{5}{2}}\,\hbar=\sqrt{\frac{15}{4}}\,\hbar$

Q → Li^+ → mangnetic moment-um (μ_L)

Sol^n → $\mu_m=\sqrt{n(n+2)}$ B.M.

$Li \Rightarrow 3$ → [↑↓] [↑]

1s 2s

unpaired e^-

Li^+ = [↑↓] [ ]

$n=0 \rightarrow \mu_m=0$



→ spin mangnetic momentum (μ_s)

→ rotation → Angular magnetic momentum (μ_L)

Mangnetic momentum → $\mu_m = \vec{\mu}_s + \vec{\mu}_L$

<u>Note</u> → 3d-series element → μ_L → very very poor → So neglect kr dena

$$\mu_m \approx \mu_s = \sqrt{n(n+2)} \text{ B.M}$$

but in case of 4d & 5d-series ⇒ μ_L have significant value

$\mu_m \simeq \mu_s + \mu_L$ → Complex formula

Aufbau principle

- It states that electrons are filled into atomic orbitals in the increasing order of orbital energy level. According to the Aufbau principle, the available atomic orbitals with the lowest energy levels are occupied before those with higher energy levels.

* $e^- \rightarrow$ Energy of subshell $\rightarrow$ increasing order me filled

* n+l Rule

① Energy of subshell $\propto (n+l)$

② $(n+l) =$ Const for 2 and more than two subshell

Energy of Subshell $\propto n$

	3s	3p	3d
$n =$	3	3	3
$l =$	0	1	2
$n+l =$	3	4	5

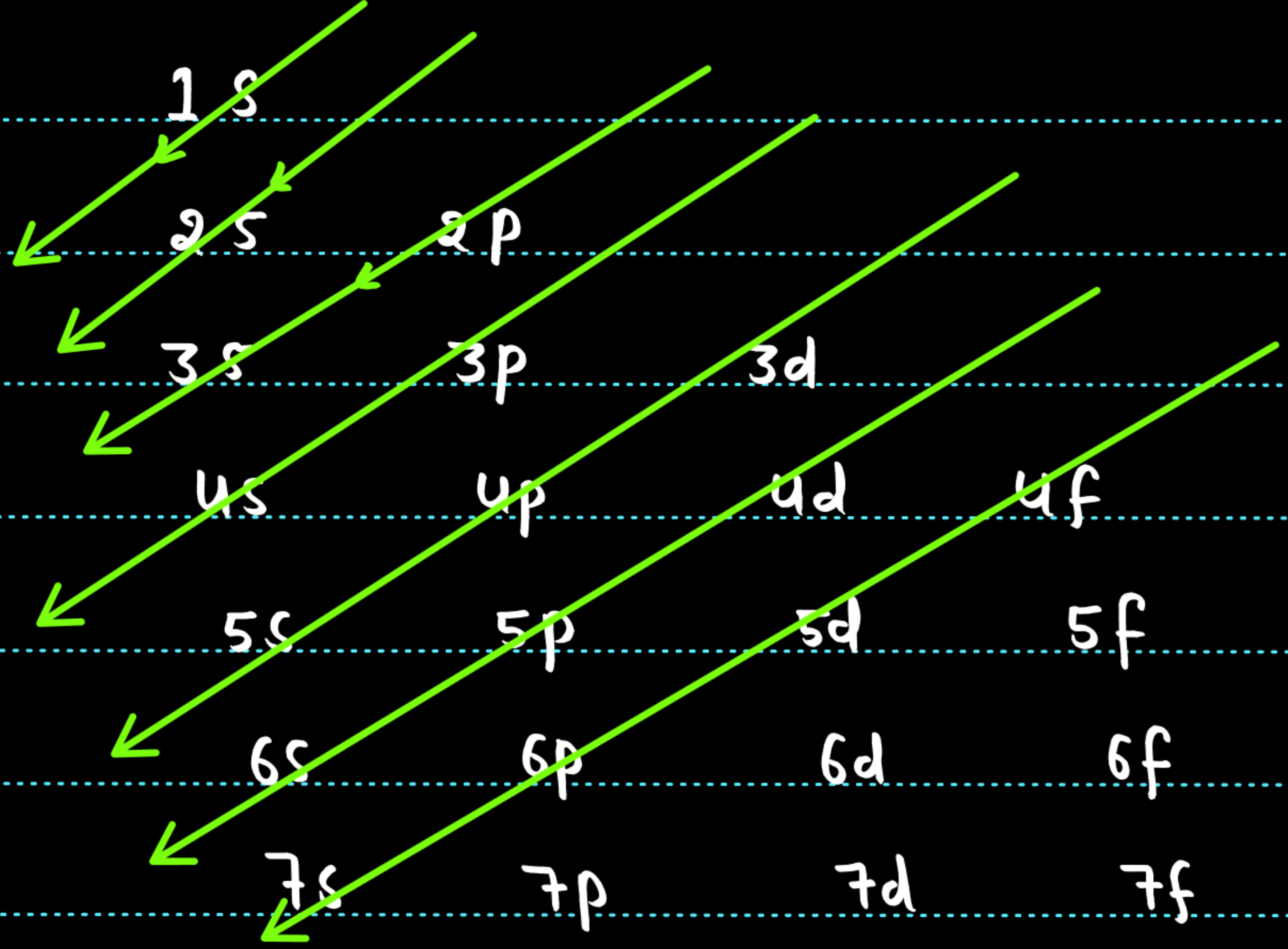
$\rightarrow 3s < 3p < 3d$

Q $\rightarrow$

	3p	4s
$n =$	3	(4)
$l =$	1	0
$n+l =$	4	4

$E \propto n$

order $\rightarrow 3p < 4s$



$$1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s$$

Na = 11 → $1s^2, 2s^2, 2p^6, 3s^1$

Cl = 17 → $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$

Cr = 24 → $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^4$ → wrong

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$ → Right

$d^4 \rightarrow d^5$, $d^9 \rightarrow d^{10}$

d^5 and d^{10} → subshell are more stable than other d subshell

d^4

↑	↑	↑	↑	

3 + 2 + 1 + 0 = 6

d^5

↑	↑	↑	↑	↑

4 + 3 + 2 + 1 + 0 = 10

Reason → due to high exchange energy

$Cu = 29$ — $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^9$ → wrong

$4s^1, 3d^{10}$ → Right

Paulie's exclusion principle

The Pauli exclusion principle states that in a single atom no two electrons will have an identical set or the same quantum numbers (n, l, m_l, and m_s). To put it in simple terms, every electron should have or be in its own unique state (singlet state). There are two salient rules that the Pauli Exclusion Principle follows:

- Only two electrons can occupy the same orbital.
- The two electrons that are present in the same orbital must have opposite spins or they should be antiparallel.

* value of four Q. No. (n, l, m, s) are not equal for any two e^- of same atom

[↑↓] → opposite spin krna hai

$1s^2$

[↑↑] → Paulie

a b

$1s^2$

[↑↓]

a b

	a	b
$n=$	1	1
$l=$	0	0
$m=$	0	0
$s=$	$+\frac{1}{2}$	$+\frac{1}{2}$

$n=$	1	1
$l=$	0	0
$m=$	0	0
$s=$	$+\frac{1}{2}$	$-\frac{1}{2}$

Hund's rule

According to Hund's rule:

- **Before the double occupation of any orbital, every orbital in the sub level is singly occupied.**
- **For the maximization of total spin, all electrons in a single occupancy orbital have the same spin.**

* orbital → same energy → pahele → sab me single e^- (same spin) hoga

$P_x = P_y = P_z$

	p_x	p_y	p_z	
p^3 –	↑	↑	↑	→ ✓
p^3 –	↓	↓	↓	→ ✓
p^3 –	↑	↓	↑	→ ✗
p^3 –	↓	↓	↑	→ ✗
p^3 –	↑↓	↑		→ ✗
p^3 –	↑	↑↓		→ ✗

	p_x	p_y	p_z	
p^2 –	↑	↑		→ ✓
p^2 –		↑	↑	→ ✓
p^2 –	↑		↑	→ ✓
p^2 –		↓	↓	→ ✓
p^2 –	↑	↓		→ ✗
p^2 –		↑↓		→ ✗

Q → select Correct arrangement of d^3-subshell

a)

↑	↑	↑		

b)

	↑		↑	↑

c)

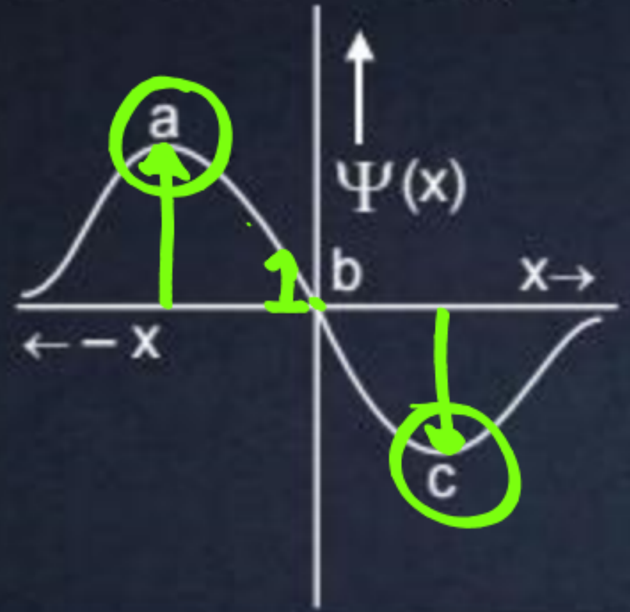
	↓	↓	↓	

d)

↓	↓	↓		

✓ e) all Correct

26. The electrons are more likely to the found (2019 Main, 12 April I)



ψ = high (Jada)

$\psi = 0$ → node → e^- cloud nahi hai

a. in the region a and c

b. in the region a and b

c. only in the region a

d. only in the region c

47. The number of nodal planes in a P_x orbital is (2001 1M)

a. One

b. Two

c. three

d. zero

$l = 1$

Q3. How many electrons can fit in the orbital for which n = 3 and l = 1?

[NEET 2016, Phase-II]

(a) 2

(b) 6 ✓

(c) 10

(d) 14

$n = 3 \rightarrow 3^{rd}$ shell

$l = \underline{1} \rightarrow$ p-subshell

No. of orbital $= 2l+1 = 2\times1+1 = 3$

$e^- = 2\times3 = 6$



Q4. Which is the correct order of increasing energy of the listed orbitals in the atom of titanium ? **[CBSE AIPMT 2015]**

(a) 3s 4s 3p 3d

(b) 4s 3s 3p 3d

(c) 3s 3p 3d 4s

(d) 3s 3p 4s 3d

(n+l) Rule

3s < 3p < 4s < 3d

	3s	4s	3p	3d
n =	3	4	3	3
l =	0	0	1	2
n+l =	3	4	4	5

Q7. What is the maximum number of orbitals that can be identified with the following quantum numbers? ($n = 3$, $l = 1$ and $m_l = 0$)

[CBSE AIPMT 2014]

(a) 1

(b) 2

(c) 3

(d) 4

$n = 3 \rightarrow 3^{rd}$ shell

$l = 1 \rightarrow$ p-subshell

$m = -1, 0, +1$

$p_z = 0$

$n = 3, m = 0$

$l = 0, 1, 2$

$m = 0 \quad 0 \quad 0$

Q6. The angular momentum of electrons in d-orbital is equal to

[CBSE AIPMT 2015]

$l = 2$

(a) $\sqrt{6}h$

(b) $\sqrt{2}h$

(c) $2\sqrt{3}h$

(d) $0h$

$\sqrt{l(l+1)}\,\hbar$

$\sqrt{2\times3}\,\hbar$

$\sqrt{6}\,\hbar$

Q11. Maximum number of electrons in a subshell with I = 3 and n = 4 is

[CBSE AIPMT 2012]

(a) 14

(b) 16

(c) 10

(d) 12

$l = 3 \rightarrow$ f-subshell $= 2 \times 3 + 1 = 7 \rightarrow 14$

$n = 4 \rightarrow 4^{th}$ shell

Q12. The correct set of four quantum numbers for the valence electron of rubidium atom (at. No. = 37) is: [CBSE AIPMT 2012]

(a) 5, 1, 1, + 1/2

(b) 6, 0, 0, +1/2

(c) 5, 0, 0, +1/2 ✓

(d) 5, 1, 0, +1/2

$Rb \rightarrow 37 \rightarrow 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^1$

$5s^1$ → Valence electron

$5s^1$

$n = 5$

$l = 0$

$m = 0$

$s = +\frac{1}{2}$

Q15. Which of the following is not permissible arrangement of electrons in an atom? [CBSE AIPMT 2009]

$n > l$

$l \geq m$

(a) $n = 4, l = 0, m = 0, s = -1/2$

(b) $n = 5, l = 3, m = 0, s = +1/2$

(c) $n = 3, l = 2, m = -3, s = -1/2$ → not possible

(d) $n = 3, l = 2, m = -2, s = -1/2$

Q31. Which of the following configuration is correct for iron?

[CBSE AIPMT 1999]

(a) $1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6 3d^5$

(b) $1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6, 4s^2, 3d^5$

(c) $1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6, 4s^2, 3d^7$

(d) $1s^2, 2s^2, 2p^6, 3s^2\ 3p^6\ 3d^6, 4s^2$

$Fe = 26 \rightarrow 1s^2, 2s^2, 2p^6, 3s^2, 3p^6$

$4s^2, 3d^6$

$n + l = 4 \rightarrow$ energy level

Q- How many subshell have same value = 3p, 4s

Q → total e^- filled in this energy level → $3p^6, 4s^2$ = (8)

$n + l = 4$

$n > l$

× 0 + 4

× 1 + 3

× 2 + 2

✓ 3 + 1 → 3p

✓ 4 + 0 → 4s

Q2. Two electrons occupying the same orbital are distinguished by

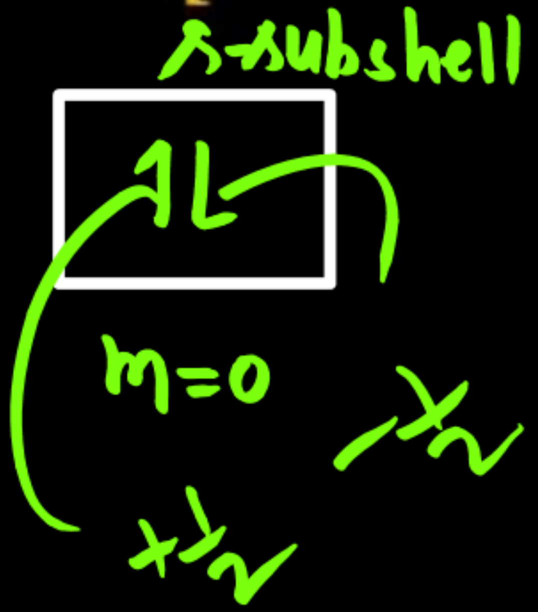
[NEET 2016, PHASE-I]

(a) Magnetic quantum number

(b) Azimuthal quantum number

(c) Spin quantum number

(d) Principal quantum number



Q50. For azimuthal quantum number $l = 3$, the maximum number of electrons [CBSE AIPMT 1991]

$3 \times 2 + 1 = 7 \rightarrow 14$

(a) 2

(b) 6

(c) 0

(d) 14 ✓

THANK YOU

All the Best!! 👍